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Vulnerability and Resilience of Social-Ecological Systems

社会・生態システムの脆弱性とレジリアンス

FY2007 FR1 Project Report

平成１９年度 FR1 研究プロジェクト報告

Project 1-3FR
プロジェクト１－3FR

Project Leader: Chieko Umetsu
プロジェクトリーダー　梅津　千恵子

March 2008
2008 年 3 月

Inter-University Research Institute Corporation, National Institutes for the Humanities
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Preface

The fiscal year 2007 was the fist year of five-year RIHN Full-Research (FR) for our project "Vulnerability and Resilience of Social-Ecological Systems."

In September 2007, we organized the first Lusaka Workshop in September and many researchers and practitioners in Zambia attended the workshop. Participants included Zambia Agricultural Research Institute (ZARI), our major counterpart, Central Statistical Office (CSO), Food Security Research Project of the Michigan State University (FSRP/MSU), Japan International Cooperation Agency (JICA) Zambia Office, and the University of Zambia (UNZA). Other organizations also showed interests toward our project activities and there is a scope for further expansion of our collaboration.

During the FY2007, we initiated the main research activities of the project in two sites. We started the field experiment for the impact of various fallow system on agricultural yield and soil nutrients in the Petauke District in the Eastern Province. In the Sinazongwe District, in the Southern Province, two graduate students finished their long-term research in the village during 06/07 cropping season and completed their thesis for their graduate program. Also one of our project researchers is staying in the village during 07/08 cropping season and conducting field observation for farms in sample villages. Their onsite observation is valuable assets for our projects. In Sinazongwe, we installed rain gauges and weather stations to collect on-farm rainfall and weather data. The intensive household survey kicked-off in October before the cropping season. The first half of the 07/08 cropping season received very heavy rain and the effects of flood became serious especially in Southern Province. The land use and forest cover information using satellite data and the data analysis of extensive household survey is underway.

The year 2007 was the year of oil price hike worldwide. The petrol and diesel price hike in landlocked Zambia increased our cost of field survey especially. This oil price hike is possible to have an indication of 3rd oil price shock in world history and its impacts on the developing economies as well as on farm households should be investigated.

Our project has just finished the first year of full-research. We appreciate 1-3PR members for their efforts for initiating research and field surveys. We also appreciate kind support by the Project Evaluation Committee (PEC) members, director, program directors, administrative staff and the colleagues of RIHN for implementing this integrated research program.

March 2008

Chieko Umetsu
1-3FR Project Leader
Research Institute for Humanity and Nature

P1－3FR Vulnerability and Resilience of Social-Ecological Systems

Project Leader： Chieko UMETSU Short name： Resilience Project

Keywords： resilience, poverty, social-ecological system, resource management, environmental variability, vulnerability, human security, semi-arid tropics

1. Purpose of Research

1.1 Research Objectives

A. Background and objective

A vicious cycle of poverty and environmental degradation such as forest degradation and desertification is a major cause of global environmental problems. Especially in semi-arid tropics (SAT) including Sub-Saharan Africa and South Asia where a majority of the poor concentrates, poverty and environmental degradation widely prevails. People in this area largely depend on rainfed agricultural production systems and their livelihoods are vulnerable against environmental variability. Environmental resources such as vegetation and soil are also vulnerable against human activities. In order to solve this “global environmental issues”, a key is a quick recovery or a resilience of human society and ecosystems from impacts of environmental variability. Thus in this project we consider society and ecology as one social-ecological system and try to perform empirical analysis for its resilience in semi-arid tropics.

B. Objectives of research

The objective of the research is 1) to consider impacts of environmental variability through vulnerability and resilience of human activities in semi-arid tropics; 2) to study factors affecting social-ecological systems and the recovery from impacts and shocks; 3) to analyze factors that form the ability of household and community to recover and the role of institution for resilience; and 4) to identify the factors affecting resilience of social-ecological systems and the ways to enhance resilience of rural people in semi-arid tropics against environmental variability.

1.2 Research Organization, Contents and Methodologies

A. Research organization

In order to achieve our objectives, we focus on four themes. Each theme interlinks with one another and thus provides comprehensive assessment of resilience of social-ecological systems. Under the supervision of theme leader, respective researchers will participate in sub-programs. Not as ordinary discipline based research groups, we organized theme based research organization. Most researchers involve more than one sub-program, thus making it possible to realize flexible research organization. The four main themes are:

Theme I: Ecological resilience and human activities under variable environment,

Theme II: Household and community responses to variable environment,

Theme III: Political-ecology of vulnerability and resilience: historical and institutional perspective,

Theme IV: Integrated analysis of social-ecological systems.

First two themes consider site specific or village level analysis and those studies are extended to temporal as well as spatial analysis in the third and forth themes for larger scales. We invited appropriate experts in the respective fields such as agronomy and soil science, agricultural and development economics, anthropology, geography, climatology, and remote sensing. The time scale of

the analysis is from 1960s to the present when the changes in social and natural environment have been accelerated.

B. Research areas

The study areas of the project are the countries in semi-arid tropics (SAT) (Figure 2). The large population in SAT live in rainfed agricultural areas and their marginal livelihood critically depends on fragile and poorly endowed natural resources. The main research area is Zambia in Southern Africa, in addition to Burkina Faso in West Africa, and India in South Asia. In Zambia, drought prone Eastern and Southern Provinces are our target research areas.

C. *Research contents and methodologies*

Theme I: Ecological Resilience and Human Activities under Variable Environment (Theme Leader: Hitoshi SHINJO)

This theme tries to capture the interaction between ecological resilience and human activities under fluctuating environment. In theme I-1, we will monitor spatial and temporal changes of soil conditions, to evaluate the components, capacity and succession of ecological resilience, e.g. organic materials and fertility related properties, succession of grass/shrub/tree communities, micro-climatic condition in above-ground and soil, and degradation of land that is expected to happen during the process of conversion from stable fallow woodland to agricultural land. In theme I-2, the influence of ecological resilience on human activities is revealed by a comparison of soil properties, which is related to ecological resilience, under different landscape, e.g. valley, slope and plane land, the types and histories of land use, and succession stages of agro-ecology.

Theme II: Household and Community Responses to Variable Environment (Theme Leader: Takeshi SAKURAI)

Rural households in the semi-arid tropics have developed various kinds of risk-management and risk coping mechanisms to respond to unpredictable rainfall. In order to serve for the integrated analysis of socio-ecological systems, the theme II investigates rural households' strategies against the erratic rainfall in four interrelated sub-themes. Theme II-1 is to measure the risky event objectively, that is, rainfall. Theme II-2 concerns with the endowments of resources available to households including physical, natural, human, financial, and social capitals. Theme II-3 is devoted to the analyses of households' behaviors: risk-management before the rain, adjustment during the rainy season, and risk-coping after harvest. And finally in theme II-4, households' resilience in risky environment is evaluated in terms of income-smoothing, consumption-smoothing, and nutritious status.

Theme III: Political-Ecology of Vulnerability and Resilience: Historical and Institutional Perspective (Theme Leader: Shuhei SHIMADA)

This theme tries to focus on the institutional aspects of social resilience in the area of semi-arid tropics. Social resilience undergoes change along with social, political and economic change and also with ecological change. It is important to understand both in the context of local history and physical settings. Theme III-1 tries to consider the change of economic policy and its impact on agricultural production and land use. Theme III-2 analyzes changes in socio-political and their impacts on land use. Theme III-3 investigates historical changes of drought responses and crop failures and the role of social institution to mitigate such situations.

Theme IV: Integrated Analysis of Social-Ecological Systems (Theme Leader: Mitsunori YOSHIMURA/Chieko UMETSU)

The primary goal of this theme is to clarify the relationship between ecological vulnerability, resilience and human activities through investigations of changes in land use and multi-level social/ ecological systems. Theme IV-1 analyzes continent scale climate monitoring to understand the mechanism of the formation of drought. Theme IV-2 investigates land use change and its impact on ecological system such as forest degradation and vegetation change using multi-temporal aerial photographs and satellite imageries. Theme IV-3 considers the role of actors of early warning systems and its effects on food security. Finally in theme IV-4 we analyze and evaluate regional resilience with extensive household survey data.

2. Common Issues and Discussions

2.1 Objectives of RIHN Project

A. Why do you conduct proposed research as a RIHN project?

As a RIHN project, it is possible to challenge research agenda that has never been accomplished in any other research funds. For our resilience project, those research agendas include an experiment of forest-clearing, collection of soil quality and rainfall data at the large number of farm households. Since a research of resilience for social-ecological systems requires researchers from many disciplines, it is a great opportunity to conduct interdisciplinary project as a RIHN project.

B. Relations to “global environmental issues” and proposed research

People who rely their production on environmental resources have vulnerable livelihood against environmental variability. In those areas, deforestation, desertification, and soil degradation caused by a vicious cycle of poverty and environment degradation are critical issues and they are recognized as one of the “global environmental issues.” The recent Environment Ministerial Summit (G-8) held in March 2005 called especially upon the need of research on impacts of climate change particularly in sub-Saharan regions. The proposed research aims at considering the impacts of environmental variability and increasing resilience of people in semi-arid tropics, which are the pressing global environmental issues for international community.

C. Research area and the relations to “global environmental issues”

The proposed research covers areas including Southern Africa region (Zambia), West Africa region (Burkina Faso), and South Asia (India). Those areas are a part of semi-arid tropics (SAT). In the semi-arid tropics (SAT) regions, the livelihood of the people is considered one of the most vulnerable to climate change. People in this area largely depend on vulnerable rainfed agricultural production systems. Increasing food security, resilience of livelihood and reducing poverty are acute issues in this area.

D. How do you utilize the results of the project to help solving “global environmental issues”?

We consider environmental degradation caused by the “vulnerability” of social-ecological systems as “global environmental issues” and the ways to enhance “resilience” of social-ecological systems as a primary goal of solving “global environmental issues”. During the research project, data collection,

observation and analysis will be conducted to find out some key indicators to resilience. By using those indices, our goal is to provide some policy options to improve the ecosystem and resource management at the end of the project.

2.2 Methods to realize “integrated” and “interdisciplinary” project

A. Characteristics and problems of methods and organization

We plan to set four themes that interlink each other in various dimensions from household and community level analysis to temporal and spatial level of analysis. Particularly we invite social scientists who are able to work with natural scientists to make use of scientific information and data for social science research agenda. Researchers joining the project this fiscal year include anthropometrics expert, cultural anthropologist, early warming system specialist, public health expert, forest ecologist. We plan to organize workshops in collaboration with other RIHN projects that share common themes and common research areas with us. Joint publication is also another option for collaborations.

2.3 Towards dissemination of the research outcomes

We plan to publish the research results as books and in academic journals and to disseminate the research results not only at the domestic meetings but also at the international research community such as IHDP. We utilize web site for making research results available to public.

3. Outcome up to now

3.1 Research Activities during the First Year of Full-Research (FR1)

A. Research organization

• Based on the MOU with Zambia Agricultural Research Institute (ZARI) which was signed in March 2007, we started a collaborative research with ZARI in Eastern and Southern Provinces.

• We organized the first Lusaka Workshop on the 3rd September 2007. Participants included Zambia Agricultural Research Institute (ZARI), our major counterpart, Central Statistical Office (CSO), Food Security Research Project of the Michigan State University (FSRP/MSU), Japan International Cooperation Agency (JICA) Zambia Office, and the University of Zambia (UNZA).

B. Methodologies

During the FY2007, we conducted literature review, field observation and interview with farmers and identified some research targets that should be included in our resilience study.

C. Results of FY2007 field research

• During the FY2007 (FR1), we set up weather stations and rain gauges, prepared experimental fields and conducted extensive household survey. After the start of rainy season in November, we started the field monitoring.

I. At the experimental site in a village in Eastern Province, survey on vegetation and topography was conducted. After land clearing, maize cultivation was commenced with the monitoring of meteorological and soil conditions. In the same villages as Theme II in Southern Province, the field trials were commenced to identify the soil fertility parameters.

II. We identified three zones in the Sinazongwe area, Southern Province based on agro-ecology, selected study sites (5 villages) in each zone, and conducted census in July 2007. Then, using the census results, 16 households were drawn as samples in each study site. In September/October, rain gauges

were installed in plots of the sample households and rainfall measurement started. In November, weekly household survey was launched.

III. Shimada participated in a seminar at the Oxford University entitled “Resilience, realities and research in African environment” and collected information on research on resilience and vulnerability and their application to development assistance. Also Nakamura studied strategies for diversifying farm livelihood, and Ito studied the role of migrant labor. Hanzawa and Kodamaya continued research on drought prone C village in the Central Province.

IV. *IV-1* We have installed meteorological observation sensors and rain gauges to monitor atmospheric environment at Southern Province, Zambia in this September. We started analysis of objective analysis data and observational data by Zambia Meteorological Department.
IV-2 The satellite imageries were obtained through the internet during the last FY2006. In this year, we have searched and purchased the useful satellite images which were observed before and after the agricultural and meteorological droughts in order to identify the land use/cover changes caused by serious droughts. Also, we investigated some principal study sites to collaborate with the theme I. Furthermore, we collected some documents and statistical data. *IV-3* We have collected documents about food security policies of Zambian government and donors, and conducted research about the food relief program in Sinazongwe district (Southern Province). *IV-4* During the field survey in September, we visited some of the sampled household for the extensive survey early 2007. Also we reviewed the methods for analyzing socio-economic data with GIS data.

- We organized five Resilience Seminars in FY2007 (23 April; 20 June; 30 July; 22 November 2007; 15 February 2008) and co-organized one RIHN Seminar (23 May 2007). We organized Hamamatsu Workshop (11-12 May), Otaru Workshop (8 March). Project web site is now available for dissemination of information. The web site address is: www.chikyu.ac.jp/resilience/. We started Resilience Working Paper Series and made them available at the project home page.

4. Forthcoming activities

A. Goal for 2nd year of Full-Research (FR2)

- We started the main research activities and trying to identify further the priorities of additional research items and make detailed research plan for the FY2008.

B. Activities in FY2008

- 1) Maize yield in the field trials will be measured and its controlling factors will be identified from measured environmental parameters. Field trials will be continued to evaluate the effects of variation in meteorological conditions on maize yield. 2) Continued monitoring and training enumerators after setting up rain gauges for rainfall data and starting intensive household surveys are necessary. 3) Hanzawa and Shimada will continue field study at C. village at Central Province, and other members will continue their studies at the villages in Southern Province. One new researcher is expected to start long-term field study in a village in Gwembe Tonga area. 4) In addition to the satellite and meteorological data accumulated as basic information, we need further to obtain data sets with different spatial and temporal scales. Also, research topics under collaboration with other themes should be accelerated.
- We will produce FR2 (interim) report by January 2009.

C. Problems and solutions for research

- We plan to consider opening a field station in Zambia for field observation and monitoring.

5. Research Activities from FY2006 to FY2011

5.1 Time Schedule

	2005 FS	2006 PR	2007 FR1	2008 FR2	2009 FR3	2010 FR4	2011 FR5
Research Methodology	xxx	xx	xx	x			
Zambia							
I. Ecological Resilience	x	xx	xxx	xxx	xxx	xx	x
II.Household/Community	x	xxx	xxx	xxx	xxx	xx	x
III. History/Institution	xx	xx	xxx	xxx	xxx	xxx	x
IV. Integrated Analysis	x	xx	xxx	xxx	xxx	xxx	xxx
India		x	x	x	x	x	x
Burkina Faso			x	x	x	x	
International Workshop			x	x			x
Project Report	FS Report	PR Report	Annual Report	Interim Report	Annual Report	Annual Report	Final Report

Figure 1: Resilience of Social-Ecological System and Four Themes

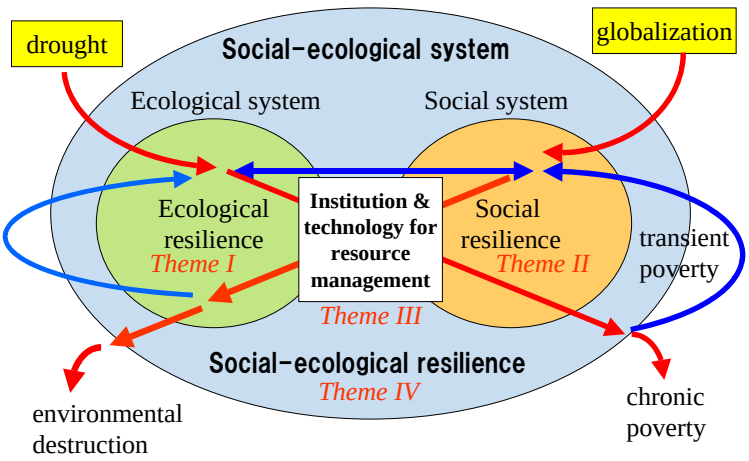
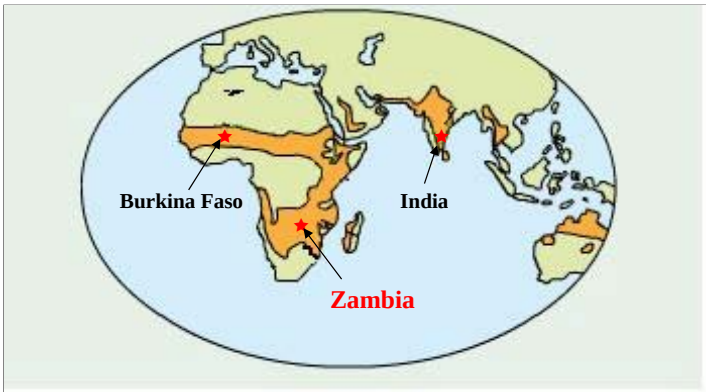


Figure 2: Regions of Semi-Arid Tropics and Study Areas



1-3FR Project Member List (FY2007)

	Name	Affiliation	Department	Title	Field	Role
Leader	Chieko UMETSU	RIHN	Research Department	Associate Professor	resource & environmental economics	Regional analysis, farm survey
A	Shigeo YACHI	RIHN	Research Department	Associate Professor	mathematical ecology	Advisor
	Theme I					
○	Hitoshi SHINJO	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Assistant Professor	soil science	organic materials and soil fertility
○	Ueru TANAKA	Graduate School of Global Environmental Studies, Kyoto Univ.	Terrestrial Ecosystems Management	Associate Professor	agronomy	soil degradation and erosion
	Shozo SHIBATA	Field Science Education and Research Center, Kyoto Univ.	Kamigamo Experimental Station	Professor	forest ecology	tree/shrub components and its succession
	Reiichi MIURA	Graduate School of Agriculture, Kyoto Univ.	Division of Agronomy and Horticulture Science	Lecturer	botany	grass/herb components and its succession
○	Hidetoshi MIYAZAKI	RIHN	Research Department	Project Researcher	soil science	measurement of land plot, crop components
○	Moses MWALE	Mt. Makulu Central Research Station, Zambia Agricultural Research Station	Ministry of Agriculture and Cooperatives	Vice Director	soil science	soil analysis
	Yoko NORO	Graduate School of Agriculture, Kyoto Univ.	Division of Environmental Science and Technology	Graduate Student (MS)	soil science	organic materials and soil fertility
	Theme II					
○	Takeshi SAKURAI	Policy Research Institute, MAFF		Senior Economist	development economics	household survey and analysis
	Hiromitsu KANNO	National Agricultural Research Center for Tohoku Region	Laboratory of Agricultural Meteorology	Team Leader	agricultural meteorology	measurement of rainfall data
	Taro YAMAUCHI	School of Medicine, Hokkaido University	Department of Health Sciences	Associate Professor	human ecology	community health and nutrition
	Theme III					
○	Shuhei SHIMADA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Professor	environmental geography	village society and institution
	Minako ARAKI	Faculty of Letters and Education, Ochanomizu University	Geography	Associate Professor	development study	village society and institution
	Kazuo HANZAWA	College of Bioresource Sciences, Nihon University	Department of International Development Studies	Professor	agricultural economics	farm household survey
	Chihiro ITO	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student (MA)	human geography	labor migration in rural area
	Gear M. Kajoba	University of Zambia	Department of Geography	Senior Lecturer	geography	land tenure system and food security
	Shiro KODAMAYA	Graduate School of Social Sciences, Hitotsubashi University	Division of African Area Studies	Professor	African sociology	agricultural development and social change
	Chileshe MULENGA	University of Zambia	Institute of Economic and Social Research	Senior Lecturer	economic geography	analysis of social behaviors
	Tetsuya NAKAMURA	Graduate School of Asian and African Area Studies, Kyoto University	Division of African Area Studies	Graduate student (MA)	agricultural economics	socio-economic responses to environmental change
	Theme IV					
○	Mitsunori YOSHIMURA	Remote Sensing Technology Center of Japan (RESTEC)		Senior Researcher	remote sensing	ecological change monitoring
	Yukiko IITSUKA	The International Peace Cooperation Headquarters, Cabinet Office	Secretariat	Programme Advisor	development studies	early warning system
○	Thamana LEKPRICHAKUL	RIHN	Research Department	Senior Project Researcher	environmental & health economics	household survey and analysis
	Keiichiro MATSUMURA	Graduate School of Human and Environmental Studies, Kyoto University	Cultural, Regional and Historic Studies on Environment	Assistant Professor	cultural anthropology	land tenure system and rural livelihood
○	Tazu SAEKI	RIHN	Research Department	Assistant Professor	atmospheric physics	climate monitoring
	Chieko UMETSU	RIHN	Research Department	Associate Professor	resource & environmental economics	regional analysis
	Megumi YAMASHITA	Survey College of Kinki		Lecturer	geographic information	vegetation monitoring
	India					
○	K. Palanisami	Tamilnadu Agricultural University	Centre for Agrl. & Rural Development Studies	Director	agricultural economics	household survey and analysis
	Akiyo YATAGAI	RIHN	Research Department	Assistant Professor	climatology meteorology	monsoon rainfall analysis
	C.R. Ranganathan	Tamilnadu Agricultural University	Department of Mathematics	Professor	mathematics	economic modelling
	B. Chandrasekaran	Tamilnadu Agricultural University	Directorate of Research	Director	agronomy	rice production analysis
	V. Geethalakshmi	Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	agriculatural meteorology	monsoon rainfall analysis
	Burkina Faso					
	Kimseyinga Savadogo	University of Ouagadougou	Department of Economics	Professor	economics	household data analysis

○＝Core Member; A = Advisor; MAFF=Ministry of Agriculture, Forestry and Fisheries

Synthesis of soil management options for better targeting of technologies and ecological resilience under variable environmental conditions

M. Mwale (Zambia Agriculture Research Institute, Mt. Makulu Central Research Station)

1.0. Abstract

Lack of access to food and its availability is of central concern in Africa and a fundamental challenge for human welfare and economic growth. Low agricultural production results in low incomes, poor nutrition, vulnerability to risks and lack of empowerment. The New Partnership for Africa's Development (NEPAD) targets an average annual increase of 6% in agricultural productivity to ensure food security and sustained national economies. Land degradation and soil fertility or nutrient depletion are considered as the major threats to food security and natural resource conservation in the semi arid tropics (SAT). What is needed is to break the cycle between poverty and land degradation in Africa by employing strategies that empower farmers economically and promoting sustainable agricultural intensification using efficient, effective and affordable agricultural technologies. Such affordable management systems should be accessible to the poor, small-scale producers and the approach should be holistic and dynamic in order to foster both technical and institutional change. This paper aims to increase the dissemination of our knowledge base on soils and its management in Zambia. This includes issues of soil conservation and conservation farming. The main activities being to: inventories available technologies for alleviating land degradation and how to demonstrate and adapt the best-bets in farmers' circumstances using farmer participatory approaches; scale up best bet technologies for sustainable land management and marketing options through the use of appropriate tools, methods and strategies; and to study the resulting ecological resilience under variable environmental conditions.

2.0. Introduction

Zambia's Agriculture is predominantly rainfed. Of the total land area of 75 million hectares, 42 million hectares, or 56%, is available for agriculture (Agricultural Statistics Bulletin, 1996). Of this, 85% is suitable for crop production. Currently, cleared land is about 14 million hectares. Land utilised for agriculture averages 1.4 million hectares per year. In terms of total agricultural land, just over 3% is currently being utilised.

Zambia is divided into three agro-ecological zones based mainly on rainfall (Veldkamp *et al*., 1984). Region I is in the southern areas of Southern and Western Provinces and the Luangwa valley of Eastern Province. It receives less than 800 mm of rainfall annually. Region II with the highest agricultural activity, is the central plateau of Eastern, Lusaka, Central and part of Southern and Western Provinces, with an annual rainfall of 800 to 1000 mm. Region III, mostly occupied by acid soils, covers large areas of Northern, Luapula, North-western and Copperbelt Provinces. It receives above 1000 mm of rainfall per annum. This zone has great potential in rainfed and irrigated agriculture due to reliable rainfall and its large number of water bodies (lakes, rivers and perennial streams).

There are approximately 850,000 farmers in Zambia. These can be grouped into three main categories. Seventy-five percent are smallholders with an average farm size of up to 5 hectares. Seventeen percent are emerging commercial farmers or emergent farmers with farm

sizes between 5 and 20 hectares. Eight percent are large commercial farmers with farm sizes exceeding 20 hectares.

The major crops grown in the country are maize *(Zea mays*), sunflower (*Helianthus annus*), soybeans (*Glycine max*), groundnuts (*Arachis hypogeae*), sorghum *(Sorghum bicolor*), cotton (*Gossypium hirsutum*), common beans (*Phaseolus vulgaris*), cowpea (*Vigna unguiculata*) sugarcane (*Saccharum officinarum*), millets (finger and bulrush), rice (*Oryza sativa*) sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), tobacco (*Nicotiana tabacum*) and wheat (*Triticum aestivum*). The cultivation methods are mainly hand-hoe. Animal draft power is used mostly in the Southern, Eastern, Western and parts of Central Provinces where animals are traditionally part of the farming systems. Use of tractors is predominantly by commercial farmers.

Maize, being the main staple food, is the single most grown crop in Zambia covering an area of 800,000 hectares. This scenario is a result of the agricultural policies of the past which over-emphasised maize production to the exclusion of other crops.

The fertilizer subsidies of the 1980's and government fixing of agricultural prices in favour of maize led to maize monoculture and the marginalization of other crops such as food legumes (Sichinga, 1996). Maize monoculture resulted in an increase in 'soil mining' causing severe soil acidification and eventual soil fertility decline (Mwale *et al.*, 1999). The traditional concept of conservation farming and sustainable agriculture was sidelined. There was over dependence on maize as a single agricultural commodity. However, other crops such as legumes are important as they are major sources of dietary proteins among smallholder farmers all over Zambia because animal proteins are expensive.

3.0. Problem Statement

The major problems causing low food production in Zambia and other countries in sub-Saharan countries are: declining soil fertility, low use of external inputs, loss of soil organic matter and soil structural damage due to poor land husbandry practices. Other constraints are natural disasters (severe drought), limited access to capital, poor information on appropriate technologies and poor marketing arrangements. These problems affect over 90% of the farmers and are getting worse due to land pressure, caused by a growing population and increasing cash demands on the farmers and the demand of agricultural support services in recent years. These problems have resulted in overall household food insecurity and widespread malnutrition. Currently the scientific community is faced with the challenge of developing new technologies or modifying and adapting already developed technologies in order to achieve increased and sustained farm level production. This paper is a synthesis of soil management options for better targeting of technologies and ecological resilience under variable environmental conditions. It is imperative to institute a multidisciplinary, multifaceted approach to combating soil fertility decline in different farming systems for the purposes of achieving increased and sustained crop production under variable environmental conditions. The technologies highlighted are those identified as key technologies with high potential to improve soil fertility, productivity and sustainability of agricultural lands, thereby enhancing the socio-economic well being of the small-holder resource-poor farmers of Zambia. Ultimately, this will lead to a more resilient healthy rural population who can increase their contributions to the national economy through their farming enterprises.

The technologies to be synthesised are further highlighted below:

4.0. Technology Synthesis

4.1. Liming

Soil pH refers to the concentration of hydrogen ions in the soil solution and is a measure of soil acidity. An acidic soil is one whose pH is below 7.0. In the tropics, acidification is rapid due to excessive leaching of bases and accumulation of Fe and Al ions. For most crops, production is negatively affected when pH falls below 5.5. Even in a situation where the initial soil pH is above 5.5, the continuous use of inorganic fertilizers eventually causes the soil pH to drop and if lime is not applied, this may render the soil become permanently barren. Acidification of agricultural lands due to inorganic fertilization is exacerbated by poor land husbandry practices of smallholder farmers characterised by mono cropping, residue burning, plough pans and declining organic matter, all of which lead to high top soil losses and yield decline over time. Research has demonstrated that regular liming results in stabilization of yields due to its ability to counteract the effects of acidification. Periodic soil testing and liming should therefore be part of the farming systems if productivity has to be maintained or enhanced.

In Zambia, soil acidity could be due to parental material, excessive inorganic fertilizer application, leaching of bases and accumulation of Fe, H and Al ions (in region III) or a combination of these factors. Excessive rains causes leaching of most of the nutrients leaving the aluminium and hydrogen ions.

In Zambia, lime is usually in the form of calcium carbonate, $CaCO_3$, commonly called calcitic lime. There are also some dolomitic limestone, or calcium magnesium carbonate ($CaMg(CO_3)_2$), deposits. Cattle manure and crop residues have been used as liming materials but with little impact.

Correction of soil acidity improves fertilizer use efficiency by crops. Liming reduces problems of aluminium toxicity, increasing the effective rooting depth. A bigger soil volume is explored for nutrients and water by the crops. Liming also improves the availability of phosphorus and some micronutrients. Liming is good for most crops, including maize but also provides the nutrient Ca for legumes such as groundnuts, cowpeas and soyabeans.

In the tropics the amount of lime to apply is normally based on the amount to neutralize Al ions in soil solution as basing on the difference between the existing soil pH and the desired pH, will normally lead to over liming resulting in micronutrient deficiencies. Sandy soils that are commonly found in most places are weakly buffered and hence have a lower lime requirement when compared with heavier clay soils.

Because some crops are more sensitive to soil acidity than others, the amount of lime to apply depends on the crops to be grown. It is also a function of organic matter content of the soil, the cost of liming and the rate at which soils become acidic. For maize-based cropping systems, the target value is between pH 4.5 and 5.5 for the humid tropics since local crops are somewhat tolerant to acidity. For most crops grown in Zambia a target soil pH value of 5.0 is a good compromise.

The soil needs to be tested to work out the amount of lime to apply per unit area. If improved agricultural systems are to be developed, the input of mineral fertilizers must be matched by

an input of lime so as to alleviate Al toxicities and avoid a decline in pH and the problems it causes. There are clearly demonstrated crop responses to lime applications, which improves pH and calcium supply. Lime is recommended to be applied at 1.0 and 1.5 to 2.0 t ha^{-1} on sandy and clayey soils, respectively every fourth year. With these rates, over liming is avoided and nutrient disorders are absent. Soils with low pH and low in magnesium can be limed with dolomitic limestone.

The economic analysis made by Mapiki, et. al (1995) can be used taking into account the current prices and revised coefficients and production responses made. Key among these measures is Value Cost Ratios and Discounted Cash Flows to measure both short term and long term economic effects of lime. Economic analysis is necessitated by farmers expecting acceptable returns on their invested resources. Since lime has both short and long term effects, this has an implication on the way economic benefits are assessed. Short term benefits are measured by the value cost ratio (VCR).

$$VCR = \frac{M\ \text{arg}\,inal\,Value\ \text{Pr}\,oduct\ (\text{MVP})}{\text{Marginal Cost Input (MCI)}}$$

Marginal value product is the value of the additional product or yield resulting from one additional unit of the input; Marginal cost input is the value of each additional unit of input. While a VCR value greater than 1 indicates profitability, VCR values greater than 2 (or 200% return) are generally considered as minimum to induce adoption of high cost soil fertility enhancing technology (Qygard, 1987).

4.2. Legume/Green Manure Based Rotation Systems

Crop rotations are important for optimum soil cover, improvement of soil fertility, reduction of pests and diseases and improved fertilizer use efficiency. Crops explore different volumes of soil due to different rooting patterns thereby increasing the uptake of soil nutrients and moisture subsequently reducing soil degradation. Rotating a cereal after a legume has beneficial effects to the cereal crop, which would utilize the residual nitrogen fixed by the legume crop the previous season. Residual inorganic fertilizers from a well fertilized cereal, such as maize, benefit greatly the succeeding legume. It is a recommended practice to rotate cowpea, soybean or common bean after a well fertilized maize crop. Expected yields following this practice are good. Crop rotations help control weeds (striga), pests (bean–stem maggot) and diseases (Helminthosporium), however, qualitative and quantitative benefits of crop rotations have not been fully carried out for all legumes of economic importance in Zambia.

In Zambian agriculture, crop production is largely dependent on inorganic fertilizer inputs. This has been exacerbated by farmer's monocropping maize (heavy user of fertilizers) year after year. This makes the use of fertiliser a prerequisite to crop production, particularly in maize and cotton. But the use of fertilizer is not sustainable due to cost and of actual availability. Therefore to boost crop production, there is need to incorporate into the system other cost-effective soil fertility improvement techniques. This is where the use of green-manure based technologies enters the agricultural picture.

Therefore, in order to demonstrate the benefits of green manure based technologies to farmers, the legume plant in the crop rotation system should alternate between a leguminous crop (e.g.

beans) and a leguminous green manure plant (e.g. sunhemp). The use of legumes in enhancing soil quality has long been recognized. "Green manuring" involves the soil incorporation of any field or forage crop while green or soon after flowering, for the purpose of soil improvement. Green manures can be annual, biannual, or perennial herbaceous plants grown in a pure or mixed stand during all or part of the year.

4.3. Cover Crop

Farmers identify low soil quality as a major problem affecting crop production in most parts of Zambia. Erratic rainfall, its poor distribution and frequent occurrence of drought have taken its toll on crop production too. In order to combat these phenomena, conservation farming through use of cover crop based technologies is being promoted among small scale farmers. In Zambia, both the development and use of cover crop based technologies is in its infant stages. In South America, Brazil in particular, this technology has proved its worth and is being used with great success. To push conservation farming forward, promotion and research in cover crops must be encouraged.

A cover crop is defined as a crop grown primarily for the purpose of adding organic matter to soil and or soil protection against erosion by water or wind usually between periods of regular crop production (Arthur et. al.1979). Cover crops, which are usually leguminous, are close growing crops that are inter–planted in young growing crops. Apart from protecting the soil from the pounding effect of raindrops, soil wash and undesirable effects of sunshine, cover crops have other advantages. By deposition of leaf litter and death of their roots, they build up soil organic matter, which improves the physical condition of soil and raises its base-exchange capacity. As the organic matter decomposes, it gradually releases plant nutrients. They also reduce leaching and roots of deeper rooting species bring up nutrients that would otherwise be lost from the subsoil which become available for the crop. In some cases cover crops also act as biological rippers. In sunny dry weather, the shedding effect of the cover crops helps to maintain soil moisture.

Cover crops must easily be propagated by seed, should grow rapidly without competing with the crop and be tolerant to some shade and cutting back from around the crop. It should also be resistant to pests and disease and should not act as an alternate host to pests or diseases attacking the crop. It should also have the capacity to suppress weed growth.

Some of the conditions which would encourage the use of cover crops by small-scale farmers are: when they are grown on land that has low opportunity costs (for example, intercropped with food or commercial crops, on land left fallow, under tree crops, or during periods of expected drought); their use requires very little additional labour (or, as in some cases, saves labour by controlling weeds especially by communities affected by HIV/AIDS); seed is readily available at no out-of-pocket cost to the farmer; and their biomass (seeds, leaves, vines) provides benefits over and above improvements to soil fertility.

Cover crops which have shown good promise to be used either in intercrops or sole crops as improved fallows or in rotation are: velvet beans (*Mucuna* spp.); Lablab bean (*Dolichos lablab*), Jack bean (*Canavalia ensiformis*), Sunhemp (*Crotalaria* spp), Pigeon Peas (*Cajanus cajan*) and Cowpeas (*Vigna unguiculata*). Cowpeas can be used as food (both leaves and grain) while Jackbean can be used as grain. Velvet beans can be intercropped with maize,

cotton or sorghum to suppress the weeds and it has the potential to be used as a food rich in protein as long as farmers are able to get rid of the toxic substance called L-Dopa. Velvet bean seed can also be used as a feed. Lablab bean can also be used both as a feed and food. Sunhemp has the potential to be pelleted into chicken feed.

4.4. Conservation Agriculture (CA)

Conservation agriculture involves adopting a number of crop husbandry practices that together comprise a complete farming system. If these practices are followed correctly, a number of important benefits arise. Figure 1 illustrates the main elements of CA while the benefits are shown in Table 1.

Table 1. ***Benefits of conservation agriculture***

Planting system	♦ Increases opportunity for early planting due to early preparation of basins or ripping
Soil fertility management	♦ Reduces soil erosion due to minimum soil disturbance ♦ Increases soil biological activity due to adequate soil organic matter input ♦ Traps soil moisture / improves water harvesting and storage ♦ Increases soil organic matter
Environment friendly	♦ Improves air and water quality
Working environment	♦ Reduces and saves on labour ♦ Reduces machinery wear and tear

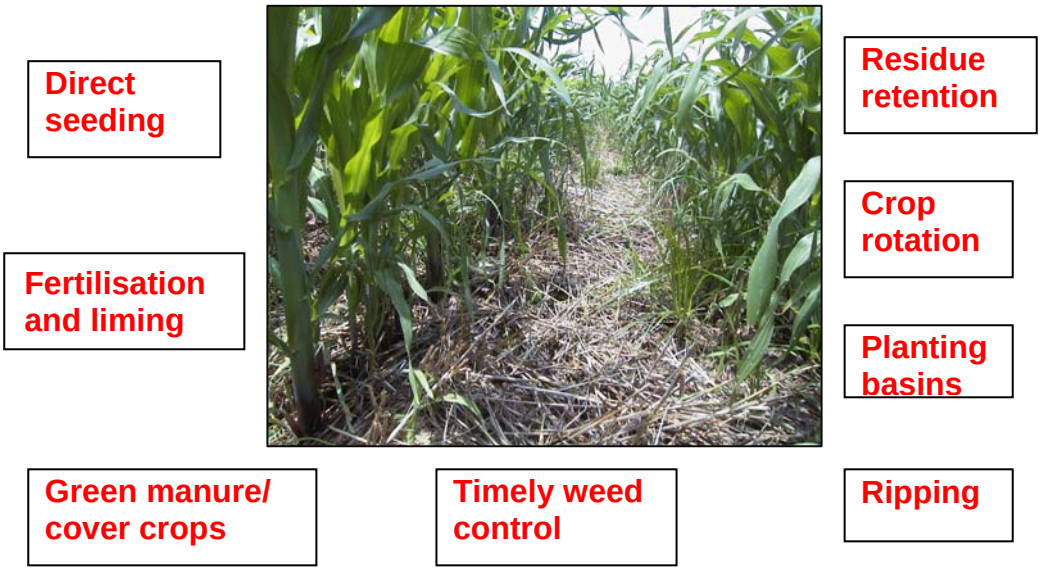


Figure 1. Main elements and benefits of Conservation Agriculture

4.5. Agroforestry and Improved Fallows

Trees play a crucial role in most farming systems and provide a range of products and services to rural and urban people. As natural vegetation is cleared for agriculture and other types of development, the benefits that trees provide are best sustained by integrating trees into agriculturally productive landscapes; a practice known as agroforestry. Farmers have practised agroforestry for many years in various forms. Agroforestry focuses on the wide range of useful trees grown on farms and in rural landscapes. Among these are fertilizer trees for land regeneration, soil health and food security; fruit trees for nutrition and food security; fodder trees that improve smallholder livestock production; timber and fuel wood trees for shelter and energy; medicinal trees to combat disease; and trees that produce gums, resins or latex products. Many of these trees are multipurpose, providing a range of benefits.

A fallow period is a period of time when a farmer decides to let his land rest in order for it to regain fertility. In an improved fallow system, fast-growing nitrogen fixing trees or shrubs are grown for 1 to 3 years in order to raise the fertility of the soil in a short period of time. The trees are of two types; those that are able to grow again when cut (coppicing trees) and those that die out when cut (Non coppicing). Some of the most important agroforestry tree species widely used for soil fertility improvement are: *Cajanus cajan, Gliricidia sepium, Tephrosia vogelii, Sesbania sesban* and *Caliandra Calothersus.* The proven legume tree species should be utilised in the areas where they perform best.

4.5.1. Proven impact of agroforestry

- ✓ Reducing poverty through increased production of agroforestry products for home consumption and sale.
- ✓ Contributing to food security by restoring farm soil fertility for food crops including production of fruits, nuts and edible oils.
- ✓ Reducing deforestation and pressure on woodlands by providing fuelwood grown on farms.
- ✓ Increasing diversity of on-farm tree crops and tree cover to cushion farmers against the effects of global climate change.
- ✓ Improving nutrition to lessen the impacts of hunger and chronic illness associated with diseases such as HIV/AIDS.
- ✓ Augmenting accessibility to medicinal trees, the main source of medication for 80% of Africa's population.
- ✓ Control and avoid soil erosion
- ✓ Cost effective or reduction on the use of inorganic fertilizers
- ✓ Used as fodder for livestock.
- ✓ Protection of crops through the use of a live fence e.g. sisal around a garden.

4.5.2. Farmer concerns

Some of the concerns that farmers have in adopting improved fallows include: Long waiting period before deriving benefits, extra labour associated with cutting and removal of plants from the field., threat of bush fires, disturbance by domestic animals which are left to graze freely especially during the period after harvest.

Table 2: Summary of soil fertility management practices in Zambia

Technology category		Practices	Advantages
Cultural practices	Crop rotation	Legumes after cereals	Reduction in fertilizer use, improved soil fertility, pest and disease control, weed control (e.g. striga)
	Agroforestry improved fallow	2-3 year fallow phase with tree species like *Gliricidia*, *Acacia, Leucaena*, *Sesbania, Tephrosia*, etc	Improve soil fertility, control and avoid soil erosion, cost effective or reduce the use of chemical fertilizer, improve soil structure, provide a fodder bank, to have source of timber, firewood, medicine, bee forge, fibber and natural remedies.
	Green manure crop fallows	Velvet beans and Sunhemp either incorporated or left on the surface	Improve soil structure and fertility, leading to vigorous growth of the following crop and reduce erosion
Compost manure practices	Mixed plant residues, animal dung, earth / soil materials, wood ash, water		Improves soil structure, reduce erosion and improves water and nutrient holding capacity of the soil.
Erosion control practices	Conservation tillage	Ripping, basins and minimum tillage	Erosion control and rain water infiltration
	Contour conservation	Vertiver grass	
Liming	Dolomitic (more magnesium than calcium) or calcitic (more calcium than magnesium) lime		Reduces soil acidity, make nutrients readily available for crop uptake and eliminates aluminium toxicity
Inoculum	*Rhizobia* inoculum		Enhances biological nitrogen fixation in legumes and increases yields
Fertilizers*	Basal and top dressing fertilizers		Supply the nutrients needed for enhanced crop production

**Wherever possible, it is recommended that farmers should combine organic and inorganic nutrient sources for sustainable crop production*

5.0. Integrated Approach

It is well appreciated that most households diversify their agricultural enterprises to try and reduce vulnerability in case one enterprise fails. A good combination of agricultural enterprises will result in positive interdependence among them to the advantage of a farmer. Figure 2 illustrates how the input cost can be minimised at a farm that practices recycling and diversification and thereby increasing resilience.

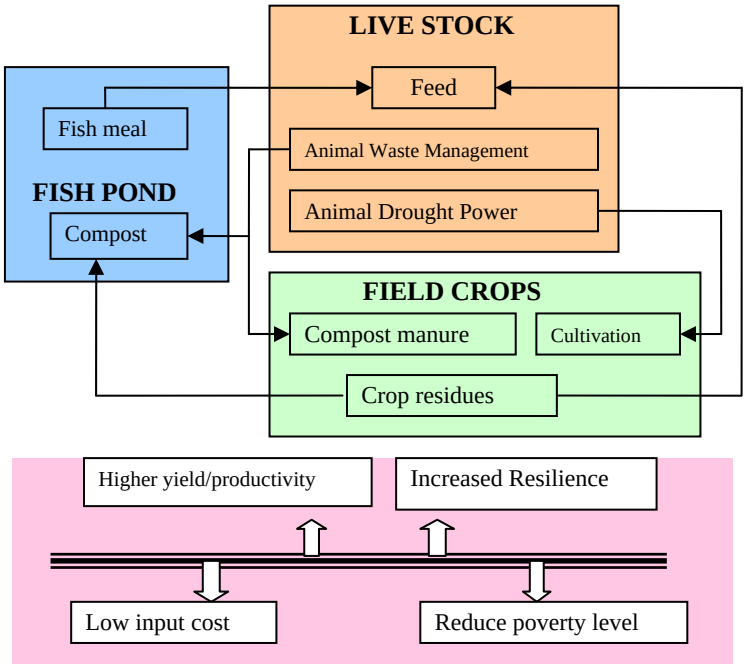


Figure 2: A form of integrated farming approach

An integrated and diversified farm does not only facilitate input cost reduction as seen in Figure 2 but also allows for a wider source of income for a small-scale farmer as shown in Figure 3:

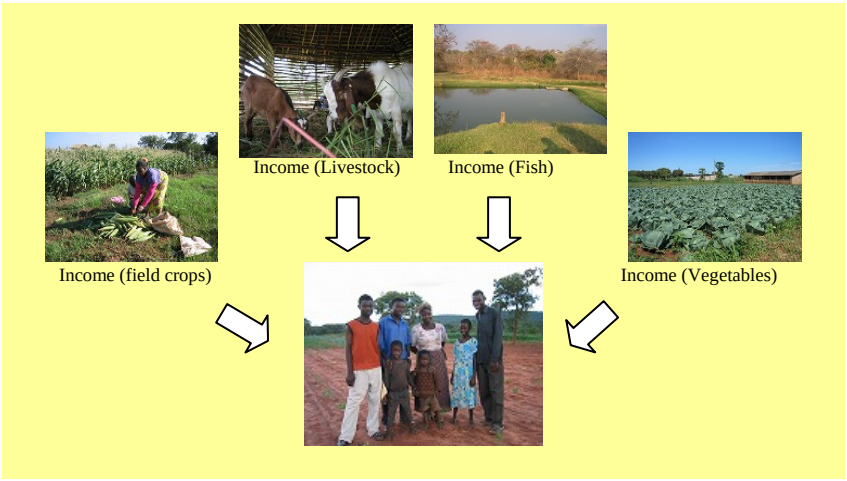


Figure 3: Integrated and diversified farm productivity gives more income

6.0. Link to the Resilience Project

Proposed Work plan for ZARI into the Resilience Project

The Zambia Agriculture Research Institute will be involved in the "Vulnerability and Resilience of Social-Ecological System" Project through activities in Theme 1. This will be

specifically focusing on the “Ecological Resilience and Human Activities under Variable Environment“ with Dr. Hitoshi Shinjo as the Theme Leader.

Field work will be conducted in Petauke District as from the 2007/08 season. Gliricidia sepium and Cajanus cajan improved fallows will be established. These will be grown for a period of three years before being sown to maize. Gliricidia sepium has the ability to coppice (re-grow after cutting) while cajanus cajan does not. Fertilized and unfertilized continuous maize will also be planted as control treatments. Two more fallow plots will be set up; traditional and natural fallow. The traditional fallow is the plot which had been cropped before and then left to rest while the natural fallow is an area which had never been cropped before. All plots will be 25 x 25 m. All treatments will be replicated three times in a randomized complete block design (See the diagram). The experiment will be conducted for a total of five years.

In order to establish the ecological resilience of the soil in these treatments, some measurements will be carried out; through the Automatic weather station set up at the site, wind speed and direction, soil temperature and moisture, air temperature and humidity, solar radiation, barometric pressure and rainfall will be recorded. In all treatments, soil respiration which is a good indicator of soil resilience will be monitored every two weeks. Soil sampling and soil hardness measurements will also be conducted on a regular basis. In all the fallow treatments, it is important to establish the vegetation types. Crop yields will also be estimated.

Plot lay out for the Agroforestry demonstration at Mwelwa Village, Petauke

5m FIRE BREAK	5 m	FIRE BREAK			
	I		**II**	**III**	
FIRE BREAK	5 TF		6 CC	1 GS	FIRE BREAK
	2 MCF		3 NF	4 MoF	
5m	3 NF		5 TF	6 CC	5m
FIRE BREAK	1 GS		4 MoF	3 NF	FIRE BREAK
	4 MoF		2 MCF	5 TF	
	6 CC		1 GS	2 MCF	
	5m FIRE BREAK	5m	FIRE BREAK		

KEY TO TREATMENTS. Replicates, I, II and III

1 = Gliricidia Sepium (GS)
2. = Maize Continuous Fertiliser (MCF)
3 = Natural Fallow (NF)
4 = Maize without Fertiliser (MoF)
5 = Traditional Fallow (TF)
6 = Cajanus Cajan (CC)

7.0. Knowledge gaps needing further research

1. There is need to establish site specific fertilizer recommendations. The current blanket recommendations are outdated and inefficient.

2. There is need to recommend appropriate combinations of organic and inorganic fertilizers for optimum utilization of scarce nutrient resources

3. There is need to quantify the amount of nitrogen fixed by legumes (green manures, cover crops and grain legumes) on farm. This has implications on the subsequent crop grown on the same piece of land and fertilization regimes that could be instituted.

4. There is need to establish the biophysical and social economic boundary conditions of legumes for better targeting of such technologies

5. Conservation farming is a promising technology but it should be promoted in areas where it has comparative advantage

6. There is need to constantly monitor soil changes (chemical, physical and biological) in long term experiments to see the impacts of such technologies on the environment

7. There is need to integrate the Geographical Information System (GIS) in soil fertility research. This would help refine the targeting of such technologies.

8.0. Conclusions and Discussion points

- ✓ The various programme working with farmers should encourage farmer to farmer extension by way of Training Farmer Trainers. This enhances farmer participation.
- ✓ Encourage exchange visits for farmers to broaden their understanding of technologies and exchange views and experiences.
- ✓ Work with the community to control bush fires and livestock in the dry season. Involvement of local leadership is necessary.
- ✓ Strengthen and encourage community seed multiplication at farm level in order to promote increase in the use of the technologies
- ✓ The demonstrations plots being promoted should be larger than 20 x 20m in order to maximize on benefits
- ✓ Legumes should not be treated as a single package for addressing soil fertility, but as an input into the whole package.
- ✓ Information on best-bets should be disseminated through field manuals, brochures, posters and technical publications
- ✓ Farmer-market linkage framework for output markets should be developed and tested with the private sector

9.0. Acknowledgements

I would like to most sincerely thank Chieko Umestu-san and her colleagues in the "Vulnerability and Resilience of Social-Ecological Systems" Project of the Research Institute for Humanity and Nature, Kyoto, Japan for having invited me as a Research Fellow during the period 1st April to 30 June 2007. Your hospitality and assistance will forever remain invaluable in my heart. I would like to specifically mention Irie Yuki-san *(Speedy)* for having made my stay in Kyoto such a memorable one! I would also like to thank my employers, the Government of the Republic of Zambia, through the Zambia Agriculture Research Institute for having granted me study leave during the said period. Finally, my wife Mabvuto, daughter Matildah Nzovwa and son Jacob Ndalitso for having endured 3 months of dads absence at home. I can assure you that your understanding here is greatly appreciated and absolutely not in vain.

10.0. References

1. Arthur W. Farral and James A. Basselman, (Ed.) (1979). Dictionary of Agricultural and Food Engineering. Interstate Printers and Publishers Inc. Danville, Illinois, USA.

2. 2000 Census of Population and Housing Report, Volume 9, 2004.

3. Gordon Wrigley (1981). Tropical Agriculture; The development of production, fouth edition. Longman, London and New York: pp 496.

4. Mwale, M., A. Mapiki, N. Mukanda, L. Bangwe and A. Mambo. 1999. A Summary of the paper presented at the FAO/MMCRS expert consultation on Soil and Nutrient Management in sub-Saharan Africa in support of the Soil Fertility Initiative (SFI), 6-9 December 1999. Lusaka, Zambia.

5. Sichinga, A. 1996. In Food Legume Crops: Fighting Malnutrition in Zambia. A Speech launching a manual guide for trainers on use of food legume crops to stop malnutrition. Lusaka, Zambia.

6. Veldkamp, W.J., M. Muchinda and A. P. Dolmotte (1984). Agro – climatic zones of Zambia. Soil Survey Unit. Department of Agriculture, Chilanga.

7. Webster, C.C. and Wilson, P.N. (1980). Agriculture in the Tropics, Second Edition. Longman, London and New York: pp. 639.

Asset Holdings of Rural Households in Southern Province, Zambia:
A Report from Census in the Study Villages

Takeshi Sakurai (Policy Research Institute)

Abstract

Theme 2 of the Resilience Project conducted a census survey in the study villages in Southern Province of Zambia, based on which sample households for household survey were selected in September 2007. This report is a detailed description of the study villages using the census data.

Sinazongwe area of Southern Province (including Sinazongwe and Choma districts) can be divided into three distinctive zones in terms of not only agro-ecology but also historical settlement pattern: namely upper slope flat land zone, middle slope zone, and lower slope flat land zone near Kariba lake. Based on village-level information collected through group interview in intentionally selected 17 villages over the three zones, 5 villages were chosen as typical villages in each zone. For upper slope flat land zone Siachaya village is selected. Siachaya is an old village that has received immigrants from villages in lower slope flat land. Two adjacent villages, Chanzika and Kanego, are selected for middle slope zone. Chanzika were established in 1990 by immigrants from villages in lower slope flat land, and Kanego were separated from Chanzika due to increasing population. In lower slope flat land, there are two types of villages: one is original and the other is relocated. The former was established by the indigenous people in this area or created by separation from such villages. The latter was created in this zone by the relocation due to Kariba dam construction. Very often, the relocated villages were forced to settle in unfavorable land. Hence, for lower slope flat land zone Siameja village is selected from the original villages and Sianemba villages is selected from the relocated villages.

Following the village selection, a census survey was conducted in the five villages from July to August 2007. Census results are given in the table below.

Table: Village Characteristics based on Census

Zone	Village	Total Population	Number of Male Adults	Number of Female Adults	Number of Households	Household Heads Born Outside
Upper Slope	Siachaya	528	100 (18.9%)	121 (22.9%)	87	25 (28.7%)
Middle Slope	Chanzika	184	43 (23.4%)	41 (22.3%)	25	24 (96.0%)
	Kanego	95	19 (20.0%)	24 (25.3%)	16	16 (100%)
Lower Slope	Siameja	215	46 (21.4%)	55 (25.6%)	37	4 (10.8%)
	Sianemba	215	63 (29.3%)	53 (24.7%)	34	6 (17.6%)
Total		1237	271 (21.9%)	294 (23.8%)	199	75 (37.7%)

Note: Adults are those who were born in 1991 or earlier (i.e. older than the age of 15 years and 7 months as of July 2007).

Since household's risk management and risk coping behaviors depend on its asset holdings, the main part of the census questionnaires asks about household assets. They are classified as physical, human, social, financial, and natural assets. This report provides a detailed description of the study villages based on this asset classification.

Training Local Health Assistants for a Community Health Survey in Zambia: Longitudinal Monitoring of the Growth and Nutrition of Children

Taro Yamauchi (Graduate School of Health Sciences, Hokkaido University)

Introduction

In Zambia, drought and unpredictable erratic rainfall is a major factor affecting the health and nutrition of the inhabitants, particularly small children. A recent national survey conducted in Zambia indicated that the nutritional status of children was poor because 50% of children between 3 and 59 months of age had stunted growth (extremely short for their age), 20% were underweight (low weight for their age), and 6% showed growth wasting (low weight for their height).

By contrast, between 1991 and 2004, data from six cross-sectional national surveys did not show any evidence of effects of drought. Therefore, an intensive, village-level, longitudinal monitoring survey is required to assess the effects of drought on the growth and nutrition of children.

To conduct a longitudinal survey to monitor the growth and nutrition of children and adults that live in villages, prospective local health assistants (enumerators) participated in an intensive 1-week program in September 2007. This report presents a summary of the 1-week intensive program to train local health assistants to make anthropometric measurements.

Local health assistant (enumerator) candidates

Initially, six youths with more than secondary school education were selected by a local supervisor, a staff from a nongovernmental organization. The youths were from villages near the subject villages. They were required to have fluency in both local language (Tonga) and English, ability to handle numerical data, basic mathematical and interviewing skills.

Training schedule

The candidates took part in a 1-week program for training to make anthropometric measurements. Training occurred at the base camp in the morning (or the whole of Day 2) and on the job at four villages (villages A, B, C, and D) in the afternoon (Table 1).

Table 1 Training schedule for 17–23 September 2007.

Day	Date	Morning	Afternoon
1	17 Sep	Equipment preparation; technical staff meet with local supervisors	
2	18 Sep	Instruction and explanation of the survey and training program, questions and answers	
3	19 Sep	Introduction to anthropometry and explanation of the equipment	Demonstration and practicing of the measurements; on-the-job training in village A
4	20 Sep	Focus training for important measurements (*i.e.*, height and skinfold thickness)	Demonstration and practicing of the measurements; on-the-job training in village B
5	21 Sep	Examination of measurements; English listening comprehension	Demonstration and practicing of the measurements; on-the-job training in village C
6	22 Sep	Instruction for three new candidates (two young men and one young women)	Demonstration and practicing of the measurements; on-the-job training in village D
7	23 Sep	Off (self-practice at home)	

Measurements and equipment

Four measurements (body length and height, weight, circumference, and skinfold thickness) were taught. The measurements, equipment, accuracy, and remarks are summarized in Table 2.

Table 2 Measurements and equipment.

Measurement	Equipment	Accuracy	Remarks
Body length	Measuring board built by a local carpenter	0.1 cm	For infants aged 0–2 years, unable to stand unaided
Height	Metal tape measure (wall mounted)	0.1 cm	For children able to stand unaided and adults
Weight	Portable digital scale	0.1 kg	
Circumference (upper arm, waist, and hip)	Plastic tape	0.1 cm	Left side
Skinfold thickness (triceps and subscapular)	Adipometer (plastic calipers)	0.2 mm	Left side

Precautions and technical problems identified during the training program

1) All measurements

- Learn to how to prepare and operate each instrument correctly.
- Learn how to read the scale and variables quickly and correctly.

2) Height

- A flat place is needed for the measurement.
- The measuring board is used for infants who cannot stand unaided.
- Ask the subjects to take off their footwear before the measurement.

3) Weight

- The scale needs to be put on a hard flat place. The results depend on the type of surface on which the scale is placed, *e.g*., soil, glass, stone, wood, concrete, etc.
- The subjects should wear light clothing (*e.g*., T-shirt and trousers/skirt).
- Take off footwear before the measurement.
- Remove heavy items such as keys and coins (purse) from the subject's pockets.
- Help children and the elderly to get on the scale, but do not touch them during the measurement.

4) Circumferences/girths

- The determination of the measurement points (surface landmarks) is important.
- The midpoint of the arm is taken as the point on the lateral side of the arm midway between the lateral border of the acromion and the olecranon when the arm is flexed at 90 degrees.
- The waist is measured as the minimum circumference between the iliac crests and lower ribs.
- Hip circumference should be measured at the level of the greatest protrusion of the buttocks.

5) Skinfold thickness

- Learn to how to operate the adipometer (a device for measuring subcutaneous fat).
- Measurement points (surface landmarks).
- For women, take care that their back is exposed when measuring the subscapular skinfold thickness.

Final examination and results

1) Measurements: Height, arm circumference, and skinfold thickness (triceps and subscapular);
2) Reading scales: Arm circumference, height, and subscapular skinfold thickness;
3) Basic skill test: Listening comprehension in both Tonga and English, arithmetic test, dictation test to measure note taking skills.

Two men and two women satisfactorily passed the anthropometric and basic skill tests. However, one woman barely passed both tests and the remaining woman clearly failed the measurement test. Additional three candidates (two men and one woman) were recruited to replace the vacant position and to keep the other two as reserved backup if qualified.

All three new comers together with the below average performer of the original group were subject to the same anthropometric measurement test. All three new comers satisfactorily passed the test. It is worth noting that the basic arithmetic test has revealed that 3 out of 8 candidates have weak mathematic skill. To avoid calculation mistakes, calculators were provided to every enumerator. The listening test also captured a candidate with possible minor degree of hearing impairment. He was instructed to repeat answers to the respondents during field interviews before recording the responses in the questionnaires.

Note

The 1-week training program was developed and conducted in cooperation with Dr. Thamana Lekprichakul. The author mainly taught anthropometric measurements and Dr. Lekprichakul organized the final examination.

References

Central Statistical Office (2003) Zambia Demographic and Health Survey 2001-2002, Lusaka, Central Board of Health.

Central Statistical Office (2005) Living Conditions Monitoring Survey Report 2004, Lusaka, CSO printing Press.

Kuczmarski RJ, Ogden CL, Guo SS et al. (2002) 2000 CDC growth charts for the United Status: methods and development. Vaital Health Stat 11, 246, 1-190.

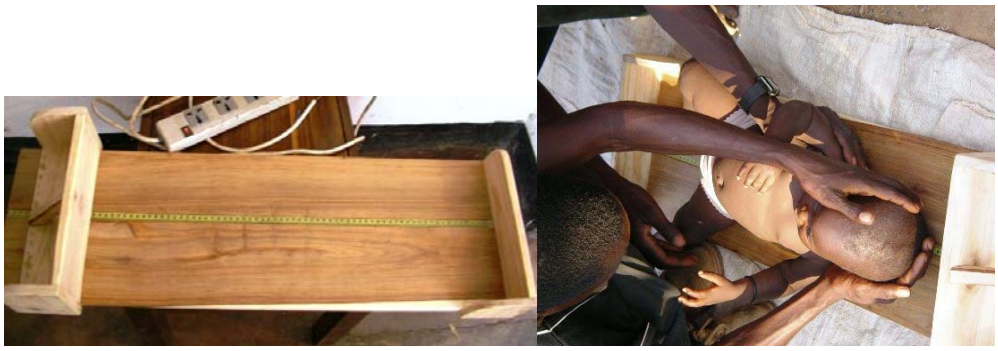
Weiner JS and Lourie JA (1981) Practical Human Biology. London, Academic Press.

World Health Organization (1983) Measuring change in nutritional status. Geneva, World Health Organization.

World Health Organization (1995) Physical status: the use and interpretation of anthropometry. Geneva, World Health Organization.

Yamauchi T (2007) Modernization, nutritional adaptability and health in Papua New Guiena Highlanders and Solomon Islanders. In Health Change in the Asia-Pacific Region: Biocultural and Epidemiological Approaches, ed. R Ohtsuka and SJ Ulijaszek, Cambridge, Cambridge University Press, pp.101-126.

Photos



Measuring board for infants

Height

Weight

Arm circumference

Subscaplar skinfold thickness

Final examination

Enumerators

Local climate and ‘proverbs of weather forecast’ in Sinazongwe

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1. Introduction

On April 2007, we have investigated the social basements in many villages in Sinazongwe District and chose the target villages of our project. At that time I have collected information about local climate and ‘proverbs of weather forecast’, and try to interpret them to connect the real meteorological phenomena.

2. Relationships between elevation, topography and local climate

1) Precipitation in upland (ca. 1000m above sea level) is larger than lowland (ca. 500m). [Mugilo Village (1018m)]

It’s from the information of people who had lived in lowland—near the lake Kariba, and moved to upland, Mugilo Village (1018m). They said that the circumstances in upland are better than lowland which they had lived before.

2) In June and July sometimes crops are damaged by frost, especially in the valley. [Sikalindi Village (1038m), Mugilo Village (1018m)]

It seems that the case of minimum temperature falls below 0℃ is not so rare. In the valley on upland, cold-air-lake is possibly made under cold weather in winter.

3. An importance of early stage in rainy season for planting schedule

The information about rainy season and agriculture are summarized as follows;

1) Delay of rainy-season-beginning causes great damage to the crops. [Sikalindi Village (1038m)]
2) Dryness in January is the worst for the crops. [Chande Village (526m)]
3) Beginning of rainy season is very important. Farmers use the flowering of Mugololo tree (Fig. 1) for the index of rainy season start. [Kanego Village (968m)]
4) In case of rain in October, farmers start to plant from flat land field because they believe that the rain in October indicates good rainy season. In the meantime, in case of no rain in October and November, farmers think that the draught will occur and start to plant from river bank fields. [Siameja Village (535m)]

In 2006 in Siameja Village, they had first rain on 19th November. Because that date was delayed from normal, farmers planted from river bank field. But on 21st January in 2007, river bank field was attacked by flood and crops were swept away

4. Cycle of flood in lowland

A flood is big problem in lowland area.

1) It heavily rained on 21st January 2007 and then flood occurred. All crops in river bank field were swept away. [Lusinga Village (528m), Kalanguwa Village (507m), Siameja Village (535m)]

2) Flood occurrence has 5-year cycle. [Lusinga Village (528m), Siameja Village (535m)]

3) Main-past-floods are; January in 1978 (scale is same as in 2007), February in 1985 (small scale), and March in 2003 (small scale). [Siameja Village (535m)]

Fig.1 Mugololo tree.

We easily image about 5-year cycle as ENSO (El Nino and Southern Oscillation) from four- to six-year cycle. In winter 2006/2007, sea surface temperature (SST) in the tropics showed El-Nino pattern and there were great drought in Australia and big flood in Jakarta, Indonesia. We should investigate the relationship between rainfall in Zambia and ENSO cycle.

5. Proverbs of weather forecast

Proverbs of weather forecast are summarized as follows;

1) In case white butterfly flies, rainy season soon comes. In case black butterfly flies, farmers will get the rain for planting. [Siabunkululu Village (1023m)]

2) When acacia tree shoots, rainy season will finish. [Siabunkululu Village]

3) When wind velocity strongly increase, rainy season will finish. Easterly wind is corresponded to dry season, and westerly wind indicates strong rain. [Siabunkululu Village]

4) When people hear the sound-of-wind, after three to four days it will rain. [Siabunkululu Village]

5) From September to October, in case water drops from Mugololo tree (Fig.1) it will fully rain. If water does not drop, farmers firstly plant on hill bottom field, and then if it rains plant on slope and hill top fields. [Sikalindi village (1038m)]

6) It rains during easterly wind blows. If wind is not stable, it doesn't rain. From October to November easterly wind blows and then rainy season starts. [Sikalindi Village]

7) If it strongly rains and next becomes hot in November, good rainy season comes. [Fodowivillage (605m)]

8) If people hear a wind sound (spiritual singing) from between two hills, they will have good rain. [Fodowi village (605m)]

9) If Mutubi tree (Fig.2) shoots from September to October, good rainy season will come. [Mugilo Village (1018m)]

10) Flowering of Mugololo tree is good index for planting. Normally it blooms around September. [Kanego Village (968m)]

11) In case of rain in October, farmers start to plant from flat land field because they believe that the rain in October indicates good rainy season. In the meantime, in case of no rain in October and November, farmers recognize the draught will occur and start to plant from river bank field. Farmers think that the rain in October is big-good-rain. [Siameja Village (535m)]

Fig.2 Mutubi tree

6. Interpretation of proverbs of weather forecast

I think that all proverbs of weather forecast do not relate to meteorological change, but some proverbs possibly indicate the relations with meteorological phenomena. My considerations are as follows;

1) Tree's shooting and flowering, dropping water:
They may be reflections of seasonal moisture increase and/or soil water increase. Whether are they caused by sporadic rain in dry season or memory of soil water long ago?

2) Definition of rainy season by the change of wind direction and speed:
Based on those proverbs, we possibly define the seasonal change by global meteorological field.

3) Forecast of rain by wind-sound:
It may be related to the rain induced by synoptic-scale disturbance.

4) Planting schedule decided by the rain in the beginning of rainy season:
It is possible that the precipitation in the beginning of rainy season restricts all amount of precipitation in rainy season. If ENSO has strong relation to rainy season in Zambia, its influence possibly continue through the rainy season, and then the precipitation in the early stage of rainy season should indicate all amount of precipitation.

7. Conclusion

We started meteorological observation from October 2007 at five villages in Sinazongwe.

Local meteorological observation data are very important not only analyzing local climate but also understanding the meanings of proverbs of weather forecast. If some of the meteorological proverbs indicate global meteorological change, the way of using proverbs to assume the meteorology field is useful for all of Africa and worth to go on the investigation about proverbs.

Resilience study presumed upon non-symmetrical relationship between ecological and social systems

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Many scholars have insisted that synthesis of ecological and social resilience is necessary. However, because of methodological difficulty, synthetic theory is still uncertain and controversial.

One of the reasons of this difficulty lies in non-symmetrical relationship between ecological and social systems. The process of social reaction to ecological change is not same as that of ecological reaction to social change. The reaction of social system to ecological change is not paralleled to that of ecological system to social change.

Some of key factors that govern social resilience when they confront with ecological hazard for example are adaptability, learning capacity and self-organizing capacity. On the other hand, the key factors that function to govern resilience of ecological system are diversification, redundancy and flexibility. This difference in governing process in social and ecological process has reflected to the discord between social scientists and ecologists. The former inclines to think social system changeable and the latter may presume ecological system symbiotic.

Thus unequal relation between social system and ecological system suggests that the study of resilience of social and ecological system can be studied separately according to specificity of each system. The consolidation of social and ecological resilience should be pursued in such a way that key factors that govern resilience of social system should be re-examined from the view point of ecological resilience. We have to ask whether the adaptability, learning capacity and self-organizing capacity that function to keep resilience of social system do also act to protect ecological resilience. But this should be done after separate studies for ecological and social systems. Otherwise the resilient study of ecological and social system can't be viable.

The Introduction of Labor migration and Solution for its Impacts by Sahelian Agropastoralists
－The case study of a village in northeastern part of Burkina Faso－

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Key Word:
labor migration, livelihood system, the Sahel

Summary

Labor migration from inland region to coastal region in Western Africa has longstanding history. However for some of people in the Sahelian area, labor migration started in the Colonial era and developed after independence. The migration contributes to migrant's household economy in the Sahelian area whose food production is insecure, whereas labor drain caused substantial impact on sustaining the livelihood system. The objective of this study is to clarify how Sahelian agropastoralists have deal with this trade-off impact of labor migration. The field study has done at the Tamashek village located in northeastern part of Burkina Faso.

Labor migration in the first stage avoided to disturb food production in the village. Junior male members who were not allowed to migrate-out were mainstay for the livelihood system in the village.

But once migrants have succeeded to build up their small business in the destination regions, they have started to practice new type of migration system, that is rotational migration system. Because of this migration system, it has become possible that even junior male members can manage successively the small business and continue food production and pasturing in the village all together. And accordingly labor migration has internalized in the livelihood system of the village people.

VULNERABILITY AND RESILIENCE OF RURAL SOCIETY IN ZAMBIA: FROM THE VIEW POINT OF LAND TENURE AND FOOD SECURITY

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ABSTRACT

The paper shows that pre-colonial ecologies of agricultural systems in some parts of rural Zambia were sustainable and resilient to prevailing environmental conditions, and were therefore able to ensure relative food security, under communal land tenure.

However, colonial policies of land alienation and labour migration impacted negatively on food production systems of some ethnic groups like the citemene system of the Bemba and the flood plain cultivation system of the Lozi, making them extremely vulnerable due to the absence of large numbers of males. Paradoxically, the Tonga people in Southern Zambia responded positively to the introduction of modern methods of cultivation, exhibiting resilience by adapting and adopting the cultivation of hybrid maize and the ox-drawn plough. They also began to transform their land tenure system from being communal to become increasingly individualised.

At independence in 1964, the UNIP government intervened strongly in promoting rural development (1964-1990), by subsidising maize production and by implementing protectionist policies to maintain communal tenure. However, food security could not be guaranteed, and the policies led to over dependence of small-scale farmers on government and on maize at the expense of other food crops.

The introduction of neo-liberal policies (from 1991 to 2001) by the MMD government coupled with adverse weather conditions, made food production systems rather vulnerable to both policy and environmental shocks. However, efforts are being made (from 2001- to date) with the assistance of cooperating partners or the international community, the United Nations System and Non Governmental Organisations (NGOs), to continue with land tenure empowerment policies to ensure secure land tenure for both men and women, and make targeted interventions with partial subsidies to rebuild the resilience of rural society, so as to promote national and household food security.

Key Words: Vulnerability, Resilience, Land Tenure, Food Security

1.0 INTRODUCTION

This paper attempts to discuss the issues of vulnerability and resilience of rural society in Zambia in the context of land tenure and food security, from a historical perspective. The discussion is accomplished through the review of literature.

According to Adger (2006), "vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt" (Adger, 2006, p. 268).

Adger (2006) states further that current research shows that there are multiple stressors and multiple pathways of vulnerability. He goes on to state that key issues in vulnerability research is to understand the stress to which a system is exposed, its sensitivity or response of the system and its capacity to adapt or capacity for adaptive action. In this regard, adaptive capacity is the ability of a system to endure in such a way as to be able to accommodate environmental hazards or policy changes.

In discussing vulnerability to food insecurity, Adger (2006) is of the view that there is need to note that food insecurity is a consequence of human activity (including production, assets or reciprocal arrangements), which can be prevented by modified behaviour and by making appropriate political or policy interventions.

Eakin and Luers (2006) are of the view that "in its most basic sense, vulnerability conveys the idea of susceptibility to damage or harm", and deals with a "sensitive exposure and sensitivity to stress and its capacity to absorb or cope with the effects of these stressors" (Eakin and Luers, 2006, p.366). It is further stressed that in the final analysis "vulnerability is fundamentally a relative concept concerned with issues of social justice, equity and opportunity" (Eakin and Luers, 2006, p.367).

Social vulnerability is defined as "the exposure of groups of people or individuals to stress as a result of the impacts of environmental change" (Adger, 2000, p.348), and involves the disruption of livelihoods, forced adaptation to changing physical environment and loss of security.

Kodamaya (2007) is of the view that although the concept of vulnerability has been used in many different research traditions, there is no consensus on its meaning. However, the concept generally refers to the exposure of groups to stress due to the impacts of environmental change. Such shocks invariably lead to the disruption of livelihoods and loss of security. On the whole, response to vulnerability is "to reduce exposure, enhance coping capacity and strengthen recovery potential" (Kodamaya, 2007, p.35).

While vulnerability is exposure to stress, resilience on the other hand is a somewhat positive concept, as it refers to the capacity for adaptation to emerging circumstances. In this regard, social resilience may be defined as "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change" (Adger, 2000, p.347).

This paper, therefore, attempts (in Section 2.0) to reconstruct some pre-colonial and colonial ecologies of agricultural or food production systems, in order to have an impression of types of land tenure, and food production systems, and the environmental and policy stresses to which they were subjected. The paper further attempts to show how vulnerable or resilient these systems were with the imposition of colonial rule and how they responded to policy and environmental shocks after the attainment of political independence on October 24, 1964.

The reconstruction is based on the chronicles of European travelers and also through reference to the surviving agro-ecological systems that were documented on the eve of colonial rule, by those who can be categorized, as Africanist colonial scholars, such as anthropologists, ecologists and agricultural scientists.

Such reconstruction has facilitated an assessment of the impacts of colonial (in Section 3.0) and post colonial policies (in Section 4.0) on land tenure and food security, showing whether the indigenous systems were vulnerable or were able to adapt and exhibit resilience.

In viewing the situation in the post-colonial period, an effort has been made to first focus on the institutional arrangements between 1964 and 1990 (Section 4.1) during the rule of Dr. Kenneth Kaunda and the United National Independence Party (UNIP). During this period, the state played a pivotal role through institutional arrangements to intervene in agriculture and regulated land tenure. Thus, an attempt has been made to assess the impact of this strong role by the state on land tenure and food security especially in relation to small holder agriculture in rural Zambia. The paper then assesses the impact of the neo-liberal policies (Section 4.2) that were introduced from 1991 to 2001 during the rule of Dr. Frederick Chiluba and the Movement for Multi-Party Democracy (MMD), on land tenure and food security. This period saw the introduction of privatization and agricultural market liberalization, which aimed at restructuring the Zambian economy so that it could be market based and be led by the private sector. Thus, the paper attempts to assess the impact of such a policy shift on land tenure, agricultural policy and the status of food security in rural Zamiba.

The assessment also covers the interventions that are being made by the New Deal Administration (Section 4.3) of President Levy Patrick Mwanawasa (of the MMD), and refers to the issue of the need to craft a national land policy that can help to reduce vulnerability and rebuild resilience of rural society in terms of future tenure arrangements and food security.

In this paper, land tenure is defined as "the rights of individuals or groups over arable, grazing and residential land, how such rights are acquired, what they consist of, how they operate in the holding, transfer and inheritance of land and how they may be extinguished" (White, 1957, p.172).

On the other hand, the Food and Agricultural Organization of the United Nations (FAO) has defined food security as a condition "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996, p.7). Thus, the paper deals with relative food security and rights in land in Zambia in the historical perspective.

2.0 PRE-COLONIAL ECOLOGIES OF AGRICULTURAL SYSTEMS

A reconstruction of pre-colonial society in Zambia in order to establish the status of land tenure, food production systems and the agro-ecological conditions upon which these were based, so as to know whether such societies were vulnerable or resilient to environmental or policy (colonial) shocks, is not an easy task. However, an appreciation of past conditions may be achieved through an evaluation of comments and recorded observations by other writers, scholars and even travelers.

2.1 Pre-Colonial Land Tenure: A General Overview

The type of land tenure that was most prevalent in pre-colonial sub-Saharan Africa in general and Zambia in particular, is what scholars have characterized as communal land tenure. In this type of tenure, individuals in various communities had free access to what is now known as common property resources (IFAD, 1995), especially land, forests, rivers, fisheries and wild life. These common property resources were vested in the traditional leaders known as chiefs and even kings and queens.

As long as an individual was an acceptable member of a community in a chiefdom, he was allowed to clear land for a field and for settlement. Such an individual however, did not own the land, but enjoyed its usufruct (Kay, 1964). The same applied to the chief. He/she did not own the land either, but held it in trust for his people. The land was owned corporately by the community as a whole (July, 1975; Yudelman, 1964).

The perception of land and other natural resources as common property was buttressed in traditional values and what seemed to be a respect for nature, in as far as low population density and technology level did not cause major disruptions in the man-environment relationship.

In terms of production, individuals as members of specific households, were free to cultivate the land that they had cleared, hunt, catch fish, extract timber for constructing their huts, harvest honey, trap rodents, graze their animals and gather wild fruits, mushrooms and other non-timber forest products. These activities were undertaken by individuals in order to meet the needs of subsistence or livelihoods and reproduce the groups.

During that time, it was assumed as Yudelman (1964) argues that nobody in the community was to be without land, and land did not naturally have a market value since these were pre-industrial societies. The abundance of virgin land and low population densities ensured that the land resources could be accessed by individuals without any or much restriction. Each household was responsible to meet its own needs of subsistence or livelihood, but weaker members of society, the infirm, widows, orphans and visitors benefited from the operation of social capital in terms of redistribution and sharing of food, and game meat, fish, beer and food between relatives.

With respect to gender relations over land, Women and Law in Southern Africa (WLSA, 2001) observes that land was broadly communally held in most of pre-colonial Southern Africa, and was allocated to male heads of the families, but women enjoyed usufruct rights over such land in their various capacities as wives, daughters or nieces. Women were not allocated land and did not inherit it in their own rights, especially in patrilineal systems such as Ngoni of Eastern Zambia, where land belongs to men directly, but were granted access to land through marriage.

In the matrilineal systems, women's rights to land were ensured. This was the case among the Bemba, Luvale, Lamba and Tonga in Zambia. Among the Lozi, a daughter was given land by her parents and her husband, but retained rights in land in her own village (Keller et al., 1990, p.242).

Manuh (1989) is of the view that the usufructuary rights in land which women held in most parts of pre-colonial Africa, could be exercised when they were single, during marriage, upon divorce or widowhood; and women could inherit land and pass it own to their children.

Married women whose husbands stayed in the wife's village (uxorilocal residence as per custom in the matrilineal groups), were able to acquire and own land over which their husbands had no rights or control. This land was obtained from their matrikin , although husbands could also give them plots of land.

Therefore, although men were considered as heads of household and played a dominant role in politics in most societies, "women had access to productive resources and were able to contribute effectively to the food self-sufficiency of their communities" (Keller et al., 1990, p.243).

It can be argued that although these pre-colonial societies were vulnerable to the vagaries of weather (since agriculture in the sub-tropics is rainfed), to locust invasion and inter ethnic conflicts, they nonetheless exhibited a semblance of resilience and (rural) people enjoyed relative food security at the level of subsistence.

It should be noted however, that pre-colonial society was not stagnant. Land tenure and social relations were not static but dynamic (Mvunga, 1980). While communal land tenure was probably the original mode of how individuals and communities related to land and other natural resources, it underwent gradual modifications with the passage of time, and especially with increase in population and changes in technology (such as the role of iron implements), changes in land usage and political relations (Kajoba, 2002).

Thus, it may be argued that in some societies in Sub-Saharan Africa (including Zambia), land use and land tenure have under gone an evolutionary transformation from the simple to the complex. This transformation involves the emergence of different land use systems from shifting cultivation to semi-permanent and even permanent forms of cultivation, involving crop rotation, use of cattle and green manure, flood plain cultivation and the incorporation of root crops that facilitated continuous cultivation and permanent settlements (Pritchard, 1979; Schultz, 1976; White, 1959).

With respect to tenure, communal tenure in some parts of Africa evolved to include lineage and more complex semi-feudal to feudal systems (Gilks, 1975), where there was more tight control of land by members of a particular lineage and by ruling groups. In these systems, certain people were excluded from easily accessing land and other resources on the basis of communal relations as was the case originally. This state of affairs was applicable to some extent in Barotse land among the Lozi people, where land lords emerged and controlled access to some resources (Clarence-Smith, 1979). Also, most of the land and cattle were controlled by the chiefly classes and land lords (Coleman, 1983) and some prolific fishing cites, turtle lakes and grazing land were reserved for the king who was considered the owner of land (Gluckman, 1968).

These internal changes interfaced with externally introduced influences with the imposition of colonial rule, leading to the emergence of market driven economic relations involving individualization of land tenure in some African societies (Howard, 1980).

Despite these gradual transformations which created complex agrarian social structures, the original communal set up did not completely disappear. It was resilient and remained the most prevalent system of accessing land and other natural resources for ensuring livelihoods and food security in most parts of pre-colonial Sub-Saharan Africa including Zambia.

2.2 Pre-Colonial Food Production Systems or Land Usage

An attempt will now be made to describe some of the food production systems or systems of land usage that existed before the coming of colonial rule in Zambia. These systems were documented by colonial scholars (especially anthropologists) who wanted to understand the workings of pre-colonial African systems. Although the documentation naturally took place during the colonial period, the major elements of the systems were remnants of pre-colonial systems and we can cautiously argue that these descriptions can give us a glimpse of what existed before the imposition of colonial rule.

2.2.1 The Bemba System of Food Production

The Bemba people reside in the Northern Province of Zambia where rainfall which exceed 1,000mm per annum has contributed to the evolution of leached sandvelt soils. Within this high rainfall agro-ecological region, the Bemba developed a system of shifting cultivation know as *citemene*.

In this system, men climbed trees in order to lop the branches that were pulled by women to create a circle that was burnt before sowing crops into the intermixed ash that was rich in potash.

At the micro level, Richards (1939) has indicated that the Bemba were able to identify different soil types such as – sandy soil – this white sandy soil was common on the plateau and was used for growing millet, sorghum, legumes, groundnuts, cassava and sweat potatoes; red soil – this was a rich red clay loam, which was considered as "the soil for food" and was sown with sorghum; black soil – this soil was found near river banks around large flood plains, swamps and small dambos – this soil was good for cultivation and was not easily exhausted. It was sown with six varieties of maize, the red variety of rice, seven varieties of beans and cucurbits, cassava, sweat potatoes, groundnuts, fruit trees and sugar cane (Gouldsbury, 1911, pp.298-299). Then there was refuse soil or *umufundo*, found on deserted villages. This soil was very fertile. It was sown with maize and cucurbits. These were known as *Mputa* gardens.

Although the Bemba are reknown for practicing *citemene*, Richards (1939) found out that they were able to practice what she called "sequences" or the beginnings of crop rotation. These rotations were practiced on the very rich red loamy soil on communal land. For instance around Malole Mission, the people were found to be practicing a 10 year rotation including finger millet, sorghum, groundnuts, cucurbits, peas and beans. Other rotations were based on cassava and sweat potatoes with millet (Richards, 1939, p.318 and p.34).

Similarly, Trapnell (1953) reported that the indigenous food production system which existed among the Bemba involved the practice of sequences which included the following:

- the millet-groundnuts-beans sequence, with the legumes sown on mounds.
- the millet-beans or double millet-groundnuts and beans sequence.
- Inter planted sorghum and millet in the first year; then sorghum for two years and then beans (Trapnell, 1953, p.46).

Although the Bemba system of food production was vulnerable due to the fact that it was dependent on rains and also suffered from other environmental shocks such as the locust invation in 1933-34, which destroyed many gardens leading to empty granaries, Richards (1939) made observations about Bemba diet that seem to emphasize the resilience of the system at that time.

She stated that "their environment provides them with a variety of foods – cereal, roots, pulses, green vegetables, fruit, honey, meat, fish and salt ---." (Richards, 1939, p.34). She went on further to emphasize that as a staple food, finger millet has had a high nutritive value compared to other cereals since it is superior in minerals like iron, calcium and phosphorous. It was also superior to cassava in protein, fat and mineral salts, although it is inferior to maize in protein and fat (Richards, 1939, p.38).

Richards also observed that the Bemba diet consisted of other valuable food stuffs that included pulses, groundnuts, ground beans and cow-peas. These were a valuable source of vegetable protein and fat. Groundnuts were particularly rich in fat and this added to their importance in a diet in which fats of all kinds were very deficient.

She further observed that animal protein was rare but it was obtained from game meat, fish and caterpillars, while green leaves (either cultivated or wild), which form the main source of vitamin C, were obtained for six or seven months from April to September. Fruits, gourds and mushrooms were also eaten as subsidiary foods, especially during the hunger months, and sweat potatoes were eaten in most seasons except during the rainy months (Richards, 1939, p.39).

These observations would seem to suggest that although the Bemba, like other, ethnic groups in Zambia depended on simple cereal based diets, the nutritive value of such diets was ensured largely by the amount of subsidiary pulses grown in addition to the main cereal crops. This, relative food security at the household and community levels, was ensured through the broadening of the food base that included the cultivation of cereals, root crops, pulses and cucurbits.

2.2.2 Food Production or Land Usage among the Tonga

According to Allan et al. (1945), the Tonga people were originally shifting cultivators who practiced subsistence agriculture combined which cattle raising, before the coming of colonial rule (Allan et al., 1945, p.2). The major crop that they cultivated was local maize. This was done on the fertile plateau soils. It was also possible for the Tonga to keep cattle because the plateau was free from the tsetse fly. Other subsidiary gardens were prepared for sorghum and pulses (Allan et al., 1945, p.6 and p.81).

Tonga custom allowed individuals to acquire land for cultivation in a number of ways. Firstly, an individual acquired land by clearing virgin or regenerated and unclaimed land. Secondly, land was obtained by transference of rights from one individual to another, temporarily or permanently. Thirdly, land was acquired by inheritance and by taking into cultivation his own vacated hut sites and their surroundings (Conroy, 1945. p.92).

The "waste lands" of the community formed a common pool from which any member of the *chisi* or community was entitled to help him self as he liked, and was made available for grazing cattle as part of common property resources.

Although the Tonga were originally shifting cultivators, it would seem that there were gradual changes in land usage. The use of cattle manure could have facilitated some families to work the same land for several decades with fallow periods (Allan et al., 1945, p.55 and p.57).

Earlier on Trapnell and Clothier (1937) had indicated that the Tonga had "developed a more elaborate and stable system ---"of cultivation in the southern plateau woodland (Trapnell and Clothier, 1937, p.35). Maize and sorghum were the major cereals which were grown in greater proportions. Sweat potatoes were planted separately in beds. Each cultivator extended his garden into the bush every year by growing groundnuts, ground beans, pumpkins and finger millet.

It was further stressed that in the Tonga village garden, a system of crop rotation was practiced. In this system, maize, finger millet, sorghum and bulrush millet, were rotated with groundnuts (and other legumes that were nitrogen fixing), creating a situation where "cultivation is thus more or less continuous" (Trapnell and Clothier, 1937, p.36).

With respect to land rights, it would seem that once land was obtained in the way stated above, individuals enjoyed a degree of security since there was no interference in the holding (Allan et al., 1945, p.63).

As a matrilineal (but patrilocal) society, Tonga women could own rights in property, both in land and in livestock, especially cattle (Conroy, 1945, p.103). It was customary for each wife in a household to cultivate a

separate garden, especially part of the extension to the garden in which she planted groundnuts, ground beans and occasionally local maize.

A grown, but unmarried woman could be given a garden at either her mother's or her father's home, and these women had the same rights in the gardens as men. Often old or widowed women would return to their brothers and cultivate land. When a single woman, neither widowed, nor divorced, got lands at one of her parents' villages, the gardens and all the crops were hers. In addition, a woman could get cattle from the marriage of her daughters, or as a gift from the head of a relative when redistribution of the estate took place (Conroy, 1945, p.104).

Thus, the cultivation of local maize and other cereals, plus pulses, groundnuts, cucurbits, and sweat potatoes; and the rearing of cattle that provided meat and milk to the diet, seem to have combined (with secure land rights for both men and women), to ensure relative food security for Tonga society, and therefore resilience of rural Tonga communities at a subsistence level, before the advent of colonial rule.

2.2.3 Food Production and Systems of Land Usage among the Lozi

The historical experience of the Lozi speaking peoples of Barotse land, now Western Province, shows that the highly complex micro-ecological conditions on the flood plain and upland, facilitated the evolution of perhaps the most complex and intense cultivation systems in pre-colonial Zambia. In the system, no less than eight different gardens were prepared. These included the following (Kajoba, 1993; Peters, 1960; Gluckman, 1968; Trapnell and Clothier, 1937):

- Margin gardens (*litongo*) – These were dry margin gardens on sandy ridges within the flood plain. They were sub classified as moist, dry and plains *litongo*. The moist *litongo* for instance were extremely fertile humus rich soils which were kept irrigated by perenial drainage along seepage lines. These soils were heavily cropped with maize, cassava, fruit trees (like paw paw and pineapples), sugar came, tabacco and vegetables. The soils were cultivated in perpetuity and fertility was restored through deposition of silt during flooding and through cattle manuring:
- Clay-gardens (*sitapa)* – These were also moist and were developed on clay soils. They were planted with sweat sorghum and local maize (with early and late maturing varieties).
- Drainage Gardens (*sishanjo)*. These were labour intensive gardens which involved the cultivation of seepage peats found along the dambo margins. The gardens were made by excavating a lattice work or network of deep drainage canals which linked up with main water courses and man made canals (Hellen, 1968). The grasses which were cleared and burnt facilitated the growing of heavy crops of maize and sweat potatoes. The gardens were also cropped with millet, pulses and cucurbits. The *shishanjo* gardens were cropped for long periods.
- Mound Gardens (*mazulu*). *Mazulu* refers to gardens that were prepared on mounds/anti-hills that occasionally occur in the Barotse plain. These provided "the most prized gardens and the only practicable site for building. Since their number in relation to the population (was) strictly limited they (were) highly valued" (Peters, 1960, p.17).

The *mazulu* were located in the ecological belt called *Bulozi,* where they rise above the flood plain and formed islands during the flood. These were very fertile and scarce. Each cultivator had only about 0.101ha. to 0.202ha., and only a few households could build huts on these mounds. One theory is that these mounds were made as part of public works by slaves (Largworthy, 1972). Allocation of such mounds was tightly controlled by the ruling groups. Crop rotation was practiced as all the mounds were fertilized with staked cattle. Local maize, sorghum, cucurbits, pulses, cassava, sweat potatoes, yams, Livingstone potatoes, groundnuts, rice, vegetables, fruits and tobacco were all grown.

- *Mukomena* – These were subdivided into dry and moist *mukomena*. The dry *mukomena* were found throughout central Barotse land. They were raized beds that were used for root crops, especially sweat potatoes, cassava and Livingstone potato. The moist *mukomena* was prepared in the perennially moist humic sands. Two crops a year were obtained due to the continuous availability of moisture. Maize and sweat potatoes were alternated (Peters, 1960).
- *Matema* – These gardens were prepared on upland in cleared forest and thicket, with a greater emphasis on the cultivation of cassava (Peters, 1960).

These systems of intensive cultivation that were practiced by the Lozi on the Zambezi flood plain and on the upland made it possible for the cultivators to grow a wide variety of crops on a permanent basis. This contributed to ensuring relative food security. To a great extent, the practice of these food production systems that facilitated continuous cultivation suggests that the food production systems were sustainable and resilient, as the communities enjoyed relative food security.

As indicated later, when David Livingstone visited the Barotse plain in 1853, he was quite impressed with the status of food security of the Lozi peoples. However, despite this, elements of vulnerability did always

exist, especially those based on possible environmental shocks such as drought, excessive flooding, livestock epidemics, as well as the impacts of colonial policies referred to in Section 3.3.

With respect to land tenure among the Lozi peoples, it could be argued that all land was vested in the Lozi king. Since land was scarce in the kingdom, it was tightly controlled and was allocated through what White (1959) called a descending hierarchy of estates.

Gluckman (1969) stated that "ultimately, the Lozi consider that all the land, and its products, belong to the nation through the king" (Gluckman, 1969, p.253). However, citizens or subjects were entitled to a right to arable land and a right to use public lands for grazing and fishing in the commons (Gluckman, 1969).

On the other hand, Clarence-Smith (1979) seems to suggest that the land tenure system among the Lozi had evolved to resemble what can be characterised as semi-feudal property relations. He states that "arable land, cattle and the more valuable fishing sites were all privately owned by a small minority, in the sense that the minority had privileged rights of access to these resources and could exclude people from obtaining access to them" (Clarence-Smith, 1979, p.221).

In the case of women's rights in land, Peters (1960) indicated that an adult woman obtained land both from her father and from her husband. A woman who was given land by her father retained such rights in land even when she got married and went to settle at her husband's house. She was free to work the land given to her by her father if it was close and the produce from such land was hers absolutely.

In the event of divorce or being widowed, a woman could return to her village and claim either her old garden back or other land could be given to her in lieu of it.

If a widow stayed with her children at her former husband's village, she still had access to the land, but such land was not hers but for the children, granted to them by their father.

When a man marries, he was expected to give land to his wife. Both the man and the woman had equal rights to the produce from that land. Such produce was for the subsistence of the household. Where the marriage was ended by divorce or death, "the produce (was) divided in half, half (went) to each partner or to his or her heirs" (Peters, 1960, p.47).

If a man polygamously married a second wife, he was expected to give her land equally with the first wife. A woman could petition for divorce if her husband did not give her land for a garden, and a man could divorce a woman by taking away her gardens (Peters, 1960).

When David Livingstone reached the Barotse plain in 1853 (south of Mongu and north of Namushakende), he made observations which show that agro-ecological conditions in the present day Western Province, were suitable and supported a wide variety of crops that included maize, millet, sorghum, cassava, sweat potatoes, beans, groundnuts, yams, melons and sugar cane (Livingstone, 1857, p.220).

He commented that "the soil is extremely fertile and the people are never in want of grain, for, by taking advantage of the moisture of the inundation, they can raise two crops a year---" (Livingstone, 1857, p.215).

Livingstone further commented that apart from cultivation of food crops, the local people (the Lozi), were able to catch fish from the Zambezi river and its lagoons, gather wild fruit and water fowl, and that this abundance of food or livelihood resources," always make the people refer to the Barotse as the land of plenty" (Livingstone, 1857, p.215).

Livingstone also observed that the Zambezi Flood Plain was covered with coarse succulent grasses "which afford ample pasturage for large herds of cattle; these thrive wonderfully, and give milk copiously to their owners ---" (Livingstone, 1857, p.215).

Apart from Barotse land, Livingstone also traveled north through the Luapula valley (on his way to Angola), and made observations on some aspects of ecologies of agricultural systems in the Luapula Valley the home of the Lunda People of Mwata Kazembe.

He indicated among other things that the land of the Lunda appeared very fertile, with many villages and gardens of cassava which was intercropped with beans or groundnuts. He observed that the villages continue to sow and reap all year round. The cereals included maize and millet, while root crops included yams and sweat potatoes. These people extended their generosity to Livingstone and his party, and he observed that "the people of the surrounding villages presented us with large quantities of food ---" (Livingstone, 1857, p.305).

Livingstone did not only visit the Barotse Plain and Kazembe's country. During his expedition along the Zambezi in 1860, he observed that in Tonga country, the river banks were intensively cultivated. He stated that "every damp spot is covered with maize, pumpkins, water melons, tobacco, and hemp" (quoted in Scudder 1962, p.37).

Between 1885 and 1888, George Westbeach also traveled through Barotse land, and he indicated in his diary that at Sesheke, he found women pounding maize and kaffir corn or sorghum in order to make coarse meal (see Tabler, 1963, p.78). This goes to suggest and confirm what Livingstone had observed earlier, that the Lozi people of Barotse land cultivated both cereals as staple crops.

When Selous passed through the present day Southern Province in the 1890's and reached the place of chief Monze near Chisekesi (in present day Monze district), he remarked that "water is extremely scarce"

(Selous, 1893, p.209), which suggests that even at that time the region experienced lower annual rainfall as it does in the contemporary times.

However, despite the scarcity of water, Selous found that Tonga people reared large herds of cattle on the "open treeless downs" covered with tall grass, and grew food crops which included maize, sweat potatoes and groundnuts (Selous, 1893, p.212; p.216; p.219).

Towards the close of the pre-colonial period, at the time when the Northern Province was being incorporated into North East Rhodesia in the 1890's, the Bemba peoples were found to be cultivating a wide variety of food stuffs. Gouldsbury (1911) who resided in Bemba country at the time of incorporation, stated that the indigenous people were found cultivating the following main varieties of crops; *Male* (Elusine Coracana) – a dwarf species of millet which was the staple; many varieties of sorghum (sorghum vulgare); millet (Pennisetum typhoideum); six varieties of maize; the red variety of rice (which was cultivated before the Arabs introduced the white seed); seven varieties of beans; pumpkins, melons and gourds; cassava; potatoes and groundnuts. Other crops included sugar cane, paw paw and bananas (Gouldsbury, 1911, p.298-299),

Angus, an explorer who had traveled through Ngoni land in the Eastern Province before 1898, observed that Ngoni villages were surrounded by "waving cornfields, which seemed unending "in their extent"; adding that "never before in any of my African wandering had I seen such an extent of land under cultivation---" (quoted in Priestly and Greening, 1956, p.2).

It can thus be deduced from the accounts of Livingstone, Selous and others that during the pre-colonial period in Zambia, the ecologies of agricultural systems were suitable for the cultivation of a variety of cereals, root crops, pulses, and others ,and the raising of livestock that contributed to ensuring relative food security at the level of subsistence.

3.0 VULNERABILITY AND RESILIENCE DURING THE COLONIAL PERIOD : 1891 -1964

The incorporation of Northern Rhodesia (now Zambia) by the British South Africa Company (B.S.A. Co.) in 1891, was followed by company rule between 1894 and 1924. After this, up to 1964, the territory was controlled directly by the British Crown.

During company rule when copper mining was still marginal, the colonial state attempted to replicate Southern Rhodesia (now Zimbabwe) policy of encouraging European Settlement (Palmer, 1973). Land was bought cheaply, especially in the Southern Province around Kalomo, Choma, and Mazabuka .

From 1903 onwards, white farmers from South Afrıca settled along the line of rail (from Livingston to the copper belt) especially in Tonga country which had fertile soil and was free from tsetse fly (Roberts, 1976). The settlers grew hybrid maize and raised cattle, mostly for the Katanga market and later for the expanding urban market, especially the copper mines. Maize and beans were produced as rations for the African miners on the copper belt. By 1911, there were 159 white farm holdings in Northern Rhodesia (Palmer, 1973, p. 57).

To secure sufficient labour for the European farmers and the mines, hut taxes were universally imposed in 1911. The colonial state used hut tax as a means of compelling Africans to offer their services since labour demands by settler farmers and the mines competed with African needs to engage in their subsistence production in the rural areas. Africans could not pay tax in kind, and so they had to offer their labour in order to raise money with which to pay the taxes.

The B.S.A. Co. also started the creation of native reserves (between 1924 and 1929), in order to set aside more land for further European settlement and also create pools of cheap African labour. These reserves were established along the line of rail,
especially in the Tonga country, in the Eastern Province around Chipata, (formally Fort Jameson), and in the Northern Province (Palmer, 1973).

A total of 19 reserves were created in the Eastern Province, 13 in the Northern Province and 16 along the line of rail (Chileshe, 2005, p. 83-84). In these provinces, land was alienated and set aside for European use, while Africans were forced to relocate into the reserves.

The opening of copper mines, the promotion of European settler agriculture, the creation of native reserves and the imposition of the hut tax, all combined to trigger a process of labor migration from the rural areas to the settler farms and the copper belt. With the expansion of copper mining in the 1920s, there were a total 46,680 Africans in 1928 who were employed within Northern Rhodesia/Zambia. This increased to 61,730 by 1929 and reached 76,626 in 1930 (N.R.G./Zambia, Native Affairs Annual Report, 1930, p. 9).

Because of labour migration, absentee rates in the rural areas were usually high. For instance, by 1938, between 50 to 60 percent of adult males from Chipata and 50 percent from Petauke ın the Eastern Province migrated to Zimbabwe and the copper belt in search of employment (Hellen 1968 p. 98, table 4). By 1961 the Northern Province had 51 percent of the male tax payers absent as migrants. In Kasempa district alone, 60 percent were absent and about 30 percent were absent from the Zambezi district (formally Balovale district) in the same year. (Hellen, 1968, p.226).

Private agencies were involved in recruiting labour in some cases. In Luapula Province, an agency run by R.W. Yule recruited up to 5,176 workers to go and work in Katanga by 1928 (N.R.G./Zambia, Native Affairs Annual Report, 1930, p. 19 and 1931,p. 30).

From the Western Province (formally Barotse land) about 50 percent of the able bodied men at any one time were recruited by an organization known as Wiltwatersrand Native Labour Association (WENELA), that sent them to work on the copper belt, Zimbabwe and South Africa (Allan and Gluckman in Peters, 1960, p. ix). By the end of colonial rule, Barotse land provided 6,000 migrant workers each year. In 1962 alone 16,000 migrants passed through Barotse land to South Africa, and 44% of all taxable males were absent by 1961 (Hellen, 1968, p. 248-249).

3.1 Vulnerability of the Bemba Food Production System

The policies by the colonial state which triggered labour migration from the rural areas of Zambia created vulnerability of rural societies, as food production systems were negatively affected.

Among the Bemba in the Northern Province, where males were required to climb trees in order to lop off branches that were then heaped together by women and burnt to make fields that were sown with millet (the staple cereal), the absence of the males undermined the *citemene* system of food production. Up to 70% of the male tax payers were absent from their villages due to labor migration. (Richards, 1939, p. xiv).The women who were left behind could not climb to lop the branches from the trees, and *citemene* agriculuture together with the Bemba village economy suffered greatly (Richards, 1939, p. 405).

Between 1939 and 1957, Richards found that" the diet of those left behind seemed to be worse… although clothing had improved and tea and sugar were in common use. A number of women without men to support them purchased food and drunkenness was more obvious in the villages. Food had begun to be bought and sold even in the rural areas "(Richards, 1939, p. xiv).

The reserves that were set aside for the use by Africans experienced congestion and over crowding by both humans and livestock. This over crowding led to land degradation, especially soil erosion. The livelihoods of the Africans in the reserves were negatively affected as land degradation led to successively poor crops. In Mkushi , the creation of reserves reduced the land available to Africans by about 64 percent. In some reserves famine conditions obtained as the food security situation deteriorated because of the failure of Africans to carry on with subsistence production practices based on the shifting cultivation mode of land use, given the limited amount of land allocated to them (Chileshe, 2005).

3.2 Resilience and Adaptation of Tonga Society

Although Tonga society was also negatively affected by labour migration, the food production system (and especially land tenure) exhibited an element of resilience in that the people adapted to the forces of modernization.

The introduction of commercial agriculture by European settler farmers (on crown land) and the adoption by Africans of such methods (hybrid maize and ox-drawn ploughs) triggered a radical transformation in the peoples attitudes towards communal land in the reserves. Pressures toward individualization of land tenure became apparent.

North et al (1961) observed that powerful socio- economic forces became operative in the Southern Province among the Tonga farmers, who began to experience a "greater sense of personal ownership" of land (North et al, 1961, p. 211).

Among the Tonga, permanent commercial agriculture had gained ground and shifting cultivation was on the way out. In Mazabuka, farmland cultivated by some Tonga farmers was being fenced with barbed wire implying personal or individual ownership of land. Even communal grazing land was being fenced.

Furthermore, a land market had also emerged. Land was being sold contrary to customary laws, although sometimes people would try to disguise the sale of land as only being a sale of 'improvements' on land. It was reported that many people in Mazabuka were openly admitting to and advocating the sale of both improvements and the land it self. (North et al, 1961).

People were making permanent or immovable improvements on land such as fences, bore holes, and brick houses. Others were spending large sums of money on purchasing agricultural implements like tractors, ploughs, cultivators, and scotch carts (North et al, 1961). In addition, White (1961, p. 3) observed that sons were inheriting farm through wills of their fathers instead of inheritance taking place matrilineally as per Tonga custom.

Allan et al (1945) were able to distinguish three categories of farmers that had emerged among the Tonga especially in Mazabuka District. Subsistence farmers were the majority who constituted 85% of the population; while small-holders (who cultivated land about twice as much as what they normally did under

subsistence) were 14% and farmer families (who had large farms that were three times the size that they could cultivate under subsistence) were only 1% (Allan et al, 1945, p. 1).

Adger (2000) contends that social resilience "is defined at the community level rather than being a phenomenon pertaining to individuals", and is therefore "related to the social capital of societies and communities" (Adger, 2000, p. 349)

From this point of view, it may be argued that many Tonga
people depended on the role of social capital in adapting their food production system, from simple subsistence to semi-commercial and even commercial market oriented production. This was done by adopting new agricultural technologies such as hybrid maize, use of chemical fertilisers, and modern implements (especially ox- drawn ploughs). These had been introduced by White settler farmers, the Seventh Day Adventist missionaries and by interventions made by the colonial state in the Peasant Farming and African Improvement Farming Schemes.

In this regard, Chipungu (1988) states that many poor individuals in the Tonga communities accessed these new technologies by borrowing ox-drawn ploughs and other agricultural implements from their richer relatives or kinsmen and even from neighbours.

Allan et al (1945) also made similar remarks. They stated that "the relations between big growers and their fellows are good. The big men even help others, by allowing them to use wells which they have sunk and by loaning implements, and above all, they have close personal ties with many. They help their own relatives to some extent, and they are nearly all Seventh Day Adventists, members of a church which seems to have a deep sense of group loyalty"(Allan et al. 1945,p.70 and p.145).

Thus, social capital or social networks contributed to the agricultural transformation that Tonga society experienced with the penetration of colonial rule and the introduction of modern methods of agriculture. These transformations occurred despite the negative impacts of taxation, creation of native reserves and labour migration.

It should be underscored that agricultural transformation among the Tonga communities contributed to the generation of agricultural incomes and increased food security. The Tonga were able to produce maize beyond basic subsistence requirements, and they even competed with European settler farmers for the maize market (Muntemba, 1980).

Individuals were thus able to purchase agricultural equipment, clothes, cattle, household goods, build permanent houses etc, reflecting an improvement in their standard of living with the introduction of the modern money economy.

However, despite this resilience exhibited through adaptation to the force of modernization, the Tonga food production system seems to have neglected the cultivation of other cereals (like sorghum and millet) and because dependent on hybrid maize. This dependency on one cereal that was less tolerant to drought was a built in aspect of vulnerability to future environmental changes or shocks.

Furthermore, the transformations in land tenure that were due to the development of commodity production, led to the vulnerability of women farmers due to the erosion of their land rights. While men devoted more arable land to the production of maize (and other cash crops like cotton and tobacco), women became more marginalized as they were allocated smaller portions of land for the cultivation of food and other subsidiary crops like groundnuts and sweet potatoes. In the native reserves the colonial administration allocated land increasingly to men rather than to women partly due to land pressure (Keller et al, 1990, p.244).

Although women continued to supply labour in the cultivation of the main fields that were controlled by their husbands for the production of cash crops, they had no control over the use of proceeds arising from the sale of such cash crops. These developments continued even after the attainment of political independence (Keller and Mbewe,1988), and highlight the complex interplay between vulnerability and resilience of rural Tonga and Zambian society, to the agricultural policies and transformations that started in the colonial period with the introduction of the money economy.

3.3 Vulnerability of the Lozi Food production System

The labour intensive flood plain or wetlands food production systems of the Lozi discussed above under section 2.2.3 became vulnerable to the impacts of colonial policies. Taxation and the abolition of tribute labour and slavery in 1906 (Coleman,1983), meant that the labour that had previously been provided for the performance of public works such as digging and maintenance of drainage canals that ensured the cultivation of *sishanjo* and other gardens was no longer available.

Migration caused a shortage of labour, and especially the shortage of cattle keepers. The combined impact of epidemics such as Contagious Bovine Pleuro-Pneumonia (CBPP); the collapse of drainage networks, with the consequent water logging of some of the most fertile soils on the plain, and excessive flooding, led to a situation where productivity of Lozi agriculture could not even provide adequate food for subsistence. The missionary Coillard who came later after David Livingstone, reported that people in Sefula were dying of hunger (Coillard, 1897, p.327).

Thus, because of colonial policies as well as environmental shocks, Barotse land became a food deficit area, and began to import maize from other parts of Zambia by the time of independence in 1964. It was estimated that up to 80,000 bags of maize per annum had to be supplied to the province at independence (Van Horn,1976,p.164).

Despite this apparent collapse of the Lozi food production system, the people continued to utilize the wetlands as well as the upland for the cultivation of sorghum, millet, sweet potatoes, rice and cassava at the subsistence level. The massive wetlands remain with great potential for agricultural development and livelihoods sustenance, due to availability of seepage zones with moisture throughout the year, cattle raising (if epidemics are controlled), fishing and timber production on upland (Kajoba, 1993; ZVAC, 2004).

4.0 VULNERABILITY AND RESILIENCE AFTER INDEPENDENCE

4.1 Vulnerability despite heavy state involvement: From 1964-1990.

In discussing issues of vulnerability and resilience of rural society in Zambia after the attainment of political independence on 24th October 1964, an effort will be made to first review the situation between 1964 to 1990, during the period of Dr. Kenneth Kaunda's rule with the then ruling United National Independence Party (UNIP).

Ncube(1983)stated that agricultural policies in Zambia since independence had emphasised among other things the following:

- The improvement of the standard of living of the rural population
- The creation of a self-reliant and progressive rural Zambia;
- The attainment of self-sufficiency in food grains; and
- The provision of infra-structure for the economic development and social stability of rural areas(Ncube,1983, p.13-14).

In order to achieve these noble objectives, the UNIP government undertook a number of agricultural/rural development programmes such as settlement schemes (to resettle people from overcrowded reserves and areas with tsetse fly); Producer Cooperatives (that attempted to promote socialist oriented production); Intensive Development Zones or IDZs (based on the growth pole theory of concentrating development efforts at specific nodes from which development could spread outwards); Intergrated Rural Development Programmes or IRDPs, (with the aim of intergrating planning, monitoring and evaluation of development projects to be run by local government institutions) ; Rural Reconstruction Centres (aimed at resettling unemployed school leavers under military discipline) ; Operation Food Production Programme (aimed at establishing state farms in the country) and the Lima Programme.

The Lima programme that was launched in 1980, was perhaps the one programme that was most popularized by the politicians. Its aim was to improve the productivity of small-scale village farmers, who were encouraged to apply chemical fertilizers on at least one quarter of a hectare, called a" Lima". This programme was donor funded , but the Zambian government was expected to provide counter part fun ding. Politicians and government extension workers from the Ministry of Agriculture, persuaded village farmers to stop shifting cultivation or *citemene* by providing them with free inputs under the National Lima Fertilizer Programme (Eklund, 1985).

The Lima programme promoted the cultivation of maize (to the exclusion of other traditional cereals) as a cash and food crop. In the Northern Province maize production between 1975-1988 increased by 850 % (Moore and Vaughen, 1994 p.206).

It may be argued that these rural development programmes, with the exception of Producer Cooperatives., Rural Reconstruction Centres, and the Operation Food Production Programme, which failed to achieve their objectives (Siddle, 1971; Bwalya,1984; Kalapula,1984), were successful to a large extent because they made it possible for rural society to access infrastructure like passable feeder roads, schools, rural health centres, clean drinking water and marketing depots.

Furthermore, the successful programmes (specially the IDZs, the IRDPs and the Lima Programme), contributed to the emergence of a small-holder class or group of commercially oriented rural producers across the entire country. This development discouraged shifting cultivation but facilitated the increase in the number of emergent farmers, who marketed at least 50% of their harvest each agriculture season (Lombard and Tweedie, 1972).

However, these programmes made rural society in Zambia rather vulnerable (especially to the vagaries of weather), for relying solely on one cereal as a staple to the exclusion of all others. The Lima programme which received much publicity and was like IRDPs, supported by donors, did not promote sorghum, millet and the root crop cassava.

The rural development programmes also contributed to vulnerability of rural society in that they created and entrenched a culture of dependency on massive state intervention in the agricultural sector that has become difficult to change.

Promotion of commercial production of maize was a carry over from colonial policy that seems to have focused on a narrow food base of one staple cereal, instead of incorporating the other food and relish crops (like pulses, beans and ground nuts) that were part of the diet in the pre-colonial period (as was shown in section 2.0). It should be noted that this trend in cereal production has also seen changes in food preference. People have become accustomed to consuming maize meal that was more accessible in urban areas, but the trend has diffused also into the rural population.

Vulnerability of rural society was more apparent because maize was more susceptible to frequent droughts leading to crop failure and therefore, low yields. During this period under review, maize production tended to fluctuate sharply over the years as shown in table 1 and figure 1. and government explained these shortfalls in terms of adverse weather conditions and sporadic out breaks of cattle diseases (GRZ, 1983).

Food self-sufficiency that had been hoped for by the government did not occur, despite heavy government intervention by subsidizing inputs, transport and the creation of an elaborate research and marketing infrastructure for maize.

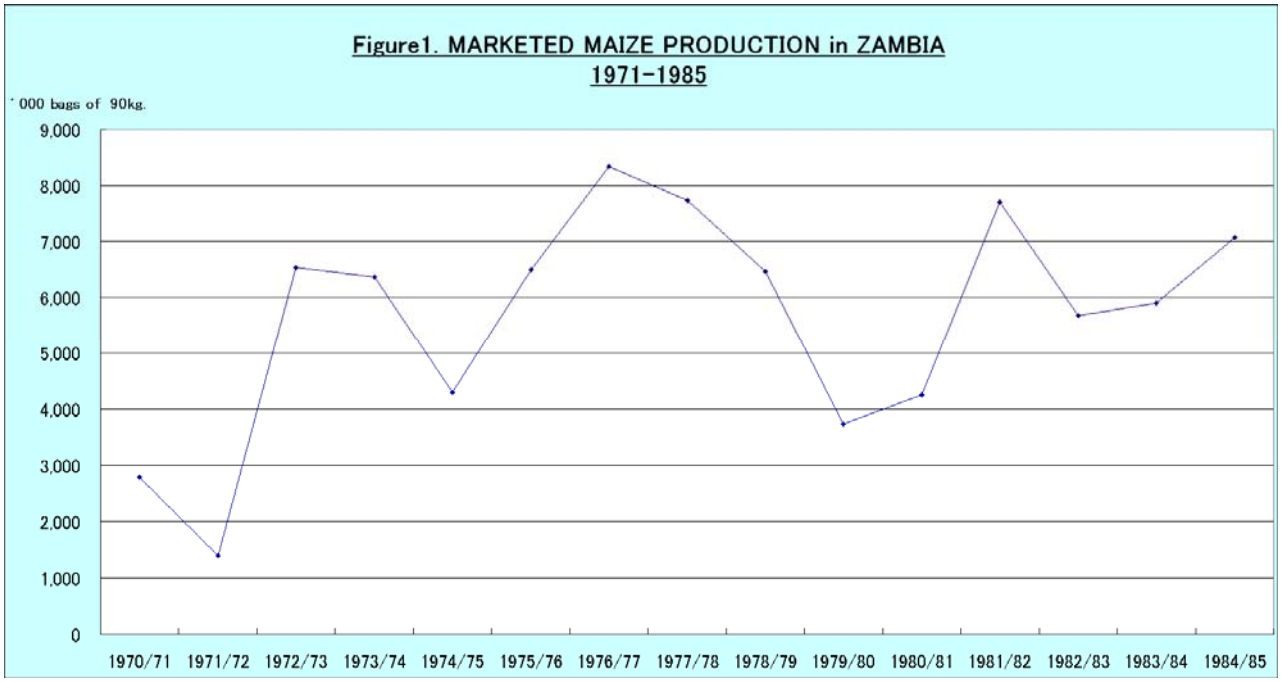
In addition, credit was made available to small-scale farmers by government supported financial institutions like LIMA Bank and Credit Union Savings Association (CUSA); while the crop was bought, transported and stored nationally by the National Agriculture Marketing Board (NAMBOARD).

For most years, maize production was just sufficient to meet national demand and imports of the cereal and other food requirements (especially for the urban population) were still required (Wood, 1990). Table 1 and figure 1 show that from the 1972/1973 agricultural season to 1978/1979 season, marketed production fluctuated around 6 to 8 million 90kg bags, although there was a drop to 4 million bags in the 1974/1975 season. From the 1979/1980 season, production was below 6 million bags except for an increase to 7 million bags in the 1981/1982 and 1984/1985 seasons.

Table1.Marketed maize production in Zambia,1971-1985

Year	' 000 bags of 90kg.
1970/71	2,791
1971/72	1,388
1972/73	6,539
1973/74	6,367
1974/75	4,290
1975/76	6,491
1976/77	8,334
1977/78	7,734
1978/79	6,463
1979/80	3,733
1980/81	4,247
1981/82	7,704
1982/83	5,672
1983/84	5,902
1984/85	7,069

(Source: GRZ 1986, Monthly Digest of Statistics, Vol. XXⅡ, No. 5 to 8, May/ August, p.6, Table8)



(Source: GRZ 1986, Monthly Digest of Statistics, Vol. XXⅡ, NO5 to 8, May/ August, p.6, Table8)

By 1975, Zambia imported 99% of its wheat, 95% of its rice, and over 80% of its potato requirements (Woldring, 1984, p.99). Large quantities of maize had to be imported from Kenya, the Unite Sates of America, Zimbabwe and South Africa in the 1979/80 and the 1980/81 seasons, to meet short fall due to low productivity, droughts and storage facilities problems.

Efforts that were being made by the government to promote the commercial production of rice in the Western Province and on the Chambeshi flats in the Northern Province, did not reduce vulnerability and increase food available for local consumption, because even rural people had become accustomed to consuming maize meal as the staple.

According to Chikulo (1986,p.5) these food imports contributed to the increase in the national debt at a time when foreign change earnings from copper had drastically declined from 64% in the 1960s to only 3% in the 1980s. Similarly, Wood (1990) points out that from 1964 to 1985, subsidies increased forty fold and worsened the budget deficit and the country's balance of payments leading to foreign borrowing.

With the commercialization of maize production, it was found that in some rural communities, women farmers tended to direct all their labour effort on maize production requirements (in order to raise incomes) at the expense of other food requirements (like pulses for relish, groundnuts and sweet potatoes).

Furthermore, some of these rural women became more vulnerable to food insecurity as they sold all their maize harvest without leaving anything for consumption. This was done in the hope that they would be able to purchase cheap subsidized maize meal on the rural markets, but, if such farmers spent all their income on other household requirements and failed to buy sufficient maize meal, they would become more vulnerable. Such miscalculation probably contributed to the apparent increase in the incidence of child malnutrition in more 'commercialized' households (Moore and Vaughen, 1987, p.540).

In this regard Sharpe (1990) points out that the Food and Agricultural Organization (FAO) and United Nations Development Programme (UNDP) noted by 1974 that the food economy and diet of Zambia was over dependent on maize and urged the diversification of food sources. He also noted that "increased production has not been translated into increased household or rural area food stocks…many households continue to suffer from absolutely inadequate food supplies…"(Sharp, 1990, p.585). This was so because food purchases did not meet household requirements.

However, despite this vulnerability of rural society in Zambia caused by over dependence on one cereal as a staple crop, there were also indications of adaptation or resilience of the food production systems. Moore and Vaughen (1994) contend that diffusion of land use practices or agricultural methods from one area to another has brought about positive change especially among the Bemba people of Northern Province.

They argue that the gradual spread of cassava cultivation from the west (among the Lunda of Luapula Province where it is combined with fishing), and the spread of green manuring (or *fundikila* from the Mambwe people within Northern Province), have combined to supplant millet as a staple food.

Furthermore, the boom that has been experienced in the cultivation of hybrid maize since the 1980s, has contributed to the decline of *citemene* and the adoption of semi-permanent cultivation methods.

While the colonial administration encouraged cassava cultivation as a famine relief crop, the root crop, together with green manuring, has spread extensively in the province. Large cassava gardens (usually interplanted with many other crops including pulses for relish) were found in the 1990s to be a wide spread feature of the landscape, and were very central to household food-sufficiency or security than the *citemene* gardens that ere sometimes cultivated alongside them (Moore and Vaughen, 1994, p.43-44).

It could be argued therefore that while government agricultural policy from 1964 to 1990 nationally promoted commercial production of hybrid maize, to the exclusion of other food crops leading to vulnerability of rural society, the gradual but independent and largely indigenous diffusion of cassava and green manuring (*fundikila*), plus state promoted hybrid maize, have all combined to make it possible for Bemba small-scale farmers to rebroaden their food base. This has been done, through the cultivation of the root crop, maize, millet, pulses(for relish) and other food crops that were inter cropped with cassava. This trend can be seen as contributing to the adaptation or the rebuilding of resilience of the food production systems (among the Bemba) and hence, to resilience of rural society after independence from 1964 to 1990.

With respect to land tenure during the UNIP rule, rural communities continued to access land and other common property resources on the basis of customary law, since the government carried over the dual land tenure system that catered for both communal and statutory tenure, as inherited from colonial rule. Thus, private (Crown land, now State land) and communal tenure (on Reserves and Trust Land) were upheld at independence.

Kajoba (1998) contends that for most of the period after the attainment of political independence , Zambia's land policies assumed a protectionist posture. By protectionism is meant the policies by which the ruling United National Independence Party and the state under Dr. Kaunda, assumed ownership or guardianship over the control of land. This was done in order to constrict private individual ownership, and was based on the ideology of Humanism which glorified customary tenure, and the assumed superiority of public ownership of the means of production, such as land, over individual private ownership (Kaunda, 1968; Kaunda, 1974).

Where rural resettlement projects were undertaken, the settlers were given 14 year leases. It would seem that like else where in sub-Saharan Africa, the majority of such settlers were men as household heads, rather than women. But men continued to rely on the labour provided by women in order to cultivate their fields. This dependence by men on women's labour was found to be a major incentive that motivated some men to enter into polygamous marriages.

For instance, a 1980 Magoye Settlement Sample study of 44 households in Southern Province among the Tonga peoples, found 50% of the settlers polygamous, and "neally all polygamous men attributed this hight incidence of polygamy to labour requirements in farming on these schemes" (Mbulo, 1985, p.137).

Similarly, Milimo (1987) observed in her research findings that" one of the main reasons that motivates men to enter into polygamous unions is the need for a large force to work on their farms" (Milimo, 1987, p.76).

In most cases, such women had no control over the use of proceeds arising from such production, as the money was controlled by their husbands. A study by Crehan (1983), in North Western Zambia and another in the rural communities of Lusaka, Northern and Western Provinces, revealed that some of the problems faced by women small-scale formers were that husbands tended to have total control of cash which was earned from joint farming efforts, and that husbands gave priority to cash crops which they controlled (Keller and Mbewe, 1988, p.19).

Towards the end of UNIP rule from November 1985 to October 1991 (after Dr. Kaunda's administration had allowed individuals on customary land to convert up to 250 hectares into a leasehold by 1985), offers of leasehold tittles to individuals for 99 years were very low.

Those to men were only 145 or 2.6% of the national total of 5,565 offers, while those to women were insignificant as they totaled only 22 or 0.4% of the national total.

In Southern Province among the Tonga for instance only 4 women as compared to 26 men were offered tittle deeds for 99years during this period. But more offers were given to the 'public sector' such as parastatals, companies and charitable organizations, in line with the protectionist policies, These totaled 5,398 or 97% of the national total (Kajoba, 1998, p.305, table).

These trends in accessing and ownership of land, food production and the control of proceeds by men, tended to marginalise women small-scale farmers, and undermined household food security as women did not control a major share of the agricultural incomes. Furthermore, this state of affairs made rural society more vulnerable to food insecurity.

In this regard, Gittinger (1990) has observed that cash cropping studies have shown that" the income controlled by women is more likely to be spent for food than the income controlled by men" (Gittinger, 1990, p.19).

4.2 Vulnerability due to Policy Shifts and Environmental shocks: 1991-2001.

According to Chabala and Sakufiwa (1993), the government of the Movement for Multiparty Democracy (MMD) and Dr. Frederick Chiluba, introduced the Structural Adjustment Programme (SAP), with the support of the International Monetary Fund (IMF) and the World Bank, in order to remove all monopolistic and excessive government involvement in the running of the economy. The new government wanted to encourage free enterprise and the operation of market forces of supply and demand, instead of a state controlled economy as was the case under UNIP and Dr. Kaunda's government.

Within the agricultural sector, structural adjustment entailed the introduction of market liberalization by which the government removed subsidies on fertilizers and other inputs, decontrolled prices of commodities including maize, and opened up marketing so as to attract competing marketing organizations.

Because of liberalization, the government began to privatize all agricultural parastatal companies so that new private sector based marketing agencies could enter the market. These changes saw the collapse of NAMBOARD, the liquidation of LIMA Bank, and collapse of CUSA and the Zambia Cooperative Finance Services, that had been responsible for providing agricultural credit to small-scale farmers.

The MMD government also eliminated exchange rate restrictions in order to encourage the establishment of' Bureau de charge', although the state continued to monitor the foreign exchange market, and also liberalized export and import trade, while providing export incentives.

On the whole, the MMD government aimed at completely liberalizing the agricultural sector involving production, marketing and input supply, but still hoped that the new framework could facilitate increased agricultural production to ensure national, regional and household food security (Chabala and Sakufiwa, 1993).

These changes in maize and fertilizer marketing policy were so radical that they created policy shocks or shifts that resulted in some very serious short term effects on production, marketing and storage of Zambia's major staple crop, maize (Chabala and Sakufiwa, 1993). Furthermore these policy shifts had implications on household food production and undermined the resilience of rural society as a whole.

It must be noted however, that according to Njobvu and Shawa (1996), some attempts at agricultural policy reform were made during Dr. Kaunda's rule, between 1983 and 1987. These included the reduction of subsidies on maize meal and fertilizer, upward adjustment of agricultural prices and deregulation of prices of all crops except maize, maize meal and fertilizer.

Unfortunately, these changes were not sustained as there was policy reversal in May 1989, when price controls were reintroduced after the country had experienced food riots in Lusaka and on the Copper belt.

Njobvu and Shawa (1996) further observed that the new government of Dr. Chiluba viewed the economic and agricultural sector policies that were pursued by the UNIP government as not sustainable as these were characterize by excessive government intervention and control.

In this regard Mwanaumo (1994, p.5) showed that maize subsidies as a percent of total government budget increased from 5.5% in 1984 to 13% in1990. This level of subsidies was a great strain on the budget as it fueled the need to borrow, thus increasing the debt stock.

Decontrol of prices, removal of subsidies on fertilizers and other inputs and deregulation of exchange rate controls, had immediate effect on the cost of fertilizers and on interest rates. Thus, small-scale farmers experienced policy shocks as there was sky rocketing of prices of fertilizers and interest rates which made it difficult for them to borrow and repay their loans.

Since fertilizers became out of reach, the small-scale farmers failed to produce maize (as before), a cash and food crop through which most of them had entered marketed production during the period of subsidies.In a study conducted by Kajoba et al (1995) in chief Mumena's area of Solwezi District, in the North Western Province the progression of interest rates charged by Lima Bank during the 1993/94 cropping season were as indicated in table 2.

Table 2. INTEREST RATES CHARGED ON LOANS BY LIMA BANK FROM SEPTEMBER 1993 TO JUNE 1995

Period	Interest Rate (% Per Annum)
September 1993	120
October-November 1993	90
December - 1993	55
January-May 1994	88
June-September 1994	60
October-November 1994	45
December 1994-January 1995	35
June - 1995	35

(Source: Kajoba et al, 1995, p.62)

Table 2 shows that the interest rates were very high and small-scale farmers complained bitterly about this policy shock, which made it difficult for them to repay the loans and be able to remain productive.

Since the 1992/93 marketing season when liberalization of maize marketing was effected, small-scale farmers were to sell their maize either to the lending institutions(to facilitate loan recovery), or they had to find other private buyers who were supposed to have entered the market. But as the government had ceased to determine the maize floor price, it meant that small-scale farmers were to negotiate with new players who had began to enter the market to fill the vacuum left by the government.

But the farmers had no such negotiating experience and it took much time for new players to fill the vacuum. Furthermore most private entrepreneurs that had entered the market, preferred to buy maize from farmers close to town as this reduced transport costs. Those private buyers who went to remote places were offering low prices for the maize because transport costs were high, especially due to impassable feeder roads that had deteriorated towards the end of UNIP rule.

These difficult changes that small-scale farmers were expected to adjust to in the agricultural sector as a result of liberalization policies, were compounded by adverse weather conditions, leading to a severe drought in the 1991/92 season. The drought which was considered the worst in that century, plus others that the country experienced in 1994/95, 1997/98, 2000/01 and 2001/02, impacted negatively on maize production throughout the country, making rural society more vulnerable to food insecurity.

These droughts reduced production of maize and other crops by as much as 60% nationally (Tiffen and Mulele 1994; Kajoba, 1998a). While area planted to maize in the late 1980s reached a peak of 1 million hectares, accounting for about 70 percent of the total cropped area, this declined significantly, probably due to policy and environmental shocks (ZVAC, 2005, p.9).

Furthermore, in cattle keeping areas such as the Southern, Central and Western Province, with 62% of the share of cattle in the traditional sector, the devastation of livestock by outbreak of cattle diseases (especially foot and mouth disease, east coast fever and contagious bovine pleural pneumonia)[CBPP], exacerbated the impact of drought and the food insecurity situation.(The Zambia Vulnerability Assessment Committee stated that there were 2,341,970 cattle by 2004 (in the traditional sector),representing a 11% drop from the 2000 estimate (ZVAC,2005,p.11).

Since cattle are a source of draught power in the communities, their loss due to livestock diseases and the impact of drought, has led to reduced area planted to maize and other cash crops. Kalapula (2007) indicates that in a study of a community in Namwala District (Southern Province), small-scale farmers reported that cultivated area had declined by 50% due to loss of oxen for ploughing due to cattle diseases.

In addition, livestock losses have deprived the rural people concerned of a source of livelihood as cattle can be sold to raise income that can be used to purchase available grain and other requirements on the rural markets.

It has been argued that the neo-liberal policies have had positive, impact. For instance, Kalinda (2002) observed that following the liberalisation of the economy, there have emerged private agribusiness enterprises in the country. These new players have replaced state owned parastatal companies which dominated marketing and input supply. Now, private sector players are involved in input supply, distribution, output marketing, agro-processing, trading and provision of finance.

Furthermore, Non Governmental Organizations (NGOs) like World Vision, Care International, Africare and others, have emerged and are important players in the provision of services to the farming community. The private sector was expected to drive economic growth, while the primary role of the government was to provide an enabling environment for such growth.

Mwefyeni (2003) found out in his research that liberalisation did not only lead to a decrease in per capita maize demand, but it also led to crop diversification as small-scale farmers produced and consumed other food crops such as sorghum, and millet; and he recommended that food policy interventions need to cover other cereals apart from maize.

The Zambia Vulnerability Assessment Committee also reported that with the importance of maize declining both in area planted and productivity and that of other cereals like sorghum, millet and rice remaining relatively stable, other crops like cotton, groundnuts and root crops (cassava and sweet potatoes), have been increasing their share in the livelihoods of Zambians. Between 1989 and 1999, the cropped area under groundnuts increased by more than 100 percent and the area for cotton increased by 65 percent. The total area planted to cassava increased by 65 percent while that for sweet potatoes increased by 54 percent (ZVAC,2005,p.10).

However, critics of government policy of agricultural liberalization and privatization of the economy argue that the changes brought by SAPs have caused unprecedented hardships on the Zambian people (Kapungwe,2003). The critics say that SAPs have caused poverty especially in the rural areas due to government withdrawal from participating in agriculture as was the case under the UNIP government. Others argue that SAPs have led to the loss of markets for maize, reduction in access to credit, input and extension support (Nyanga, 2006).

Kalinda (2002) states that poverty levels in Zambia in general are high, but they are much higher and more severe among the rural populations. In 1991, it was reported that 69.7% of all Zambians "were living below the poverty line with expenditure below the level to provide for basic needs" (Kalinda, 2002,p.61).

By 1996, the incidence of poverty was 82.8% for rural and 46.0% for urban areas. The highest incidence of rural poverty is found in Western Province at 94%, followed by North Western and Luapula Provinces at 92%.

It is further argued that despite occasional surpluses of maize which is produced in good crop years, Zambia's food security situation remains precarious. Food insecurity has led to chronic malnutrition which has affected about 45 to 47% of the rural households, while wasting has inflicted about 6% of all rural households (Kalinda, 2002,p.67). Among children, poverty is manifested in stunting, wasting and being underweight (Kapungwe, 2003, p.34).

In terms of gender, it is contended that female headed households are more vulnerable to poverty than male headed households, probably because women headed households tend to be resource poor and lack labour that is needed to increase agricultural production. In Western Province, 93% of the women were poor with more than 85% being extremely poor (Kapungwe, 2003, p.26).

While critics blame the government for increased incidences of rural poverty, Kalinda (2002) is of the view that key factors that explain rural poverty are many, but they include lack of access to productive resources, geographical isolation (causing lack of access to services and rural markets), lack of productive assets (such as oxen and farm equipment), which constrain agricultural productivity, and lack of labour in some house holds. Lack of labour is exacerbated by the devastating impact of HIV/AIDS in rural communities, as scarce financial resources meant to purchase agricultural inputs are diverted to provide medical care over prolonged periods, thus undermining food security.

The government on its part is of the view that while initial focus of policy following the introduction of SAPs was on ensuring overall macro-economic stability, effort is now being made through the implementation of the Poverty Reduction Strategy Paper (PRSP), to deal with issues of economic growth, poverty reduction and the fight against HIV/AIDS (Mulungushi, 2003, p.74), whose prevalence rate nationally was at 14.4% in 2004 (CSO,2006, p.45).

It should be underscored however, that the policy shifts that were embedded in SAPs and environmental shocks due to droughts, livestock epidemics, and the HIV/AIDS pandemic, were a major turning point for Zambia after independence. These shocks had implications relating to vulnerability of rural society and they combined to undermine livelihoods and food security.

In as far as land tenure is concerned, the MMD government of Dr. Chiluba also created conditions for a major shift in how people perceived land. While the UNIP government of Dr. Kaunda promoted protectionist policies as stated earlier, the MMD government on the other hand introduced policies of empowerment (Kajoba, 1998).

Empowerment refers to the set of policies which embody the philosophical position that individual farmers, both men and women, together with local and external investors, should be allowed the opportunity to own land privately under leasehold title, so that such land may have market value, and be an incentive to those who posses it. Such land owners could become motivated to use it more productively and in a sustainable way as interested stake holders with secure title.

After a heated national debate, the MMD government anacted the 1995 Lands Act which was passed by Parliament. The law upheld the dual land tenure system, but made provision for those who hold land under customary tenure to convert it into a leasehold not exceeding 99 years. This provision was similar to that made

under UNIP rule in 1985, which allowed conversion of up to 250 hectares. But conversion under the 1995 Lands Act, was to take place only if the chief in accordance with customary law on tenure and the local government authority gave consent.

With the popularization of the perception under MMD rule, that land had a monetary value, in the process of economic liberalization, more individuals became motivated to apply for title deeds. Thus, in the first six years of MMD rule, a total of 28,107 offers for leasehold title were made by the Commissioner of Lands. Of these, 18,651 or 66.4% were offered to men, while 3,943 or 14.0 % were given to women. The public sector or others like parastatal companies were offered only 5,513 leases or 19.6% (Kajoba, 1998, p.307).

Therefore, there was a big difference between the number of offers for title deeds during the last six years of UNIP rule and those made during the first six years of MMD rule. More individuals (men and women) rather than the 'public sector' were empowered with title deeds under the MMD regime compared to those in the last six years of the UNIP era, where protectionism was practiced. The offers for title deeds include those made in the rural provinces.

The increase in title deeds offered after land conversion has not gone without criticism however. It has been argued by government critics that market based land reforms or conversion of customary land to leasehold tenure has led to exclusion, and displacement of local people; conflict between some chiefs and their subjects, and enclosure of common pool resources. These trends are associated especially with tourist operators who have fenced off or patrol river frontages (like the Zambezi, South Luangwa and Lake Kariba). Such measures have apparently prevented local people from accessing water, fisheries and watering their animals (Brown, 2005).

This outcry probably influenced the Mung'omba Constitution Review Commission (CRC, 2005), to recommend that common property resources like Islands, river frontages and lakeshores should not be privatized or sold off to private individuals (CRC, 2005, p.325).

The Chiluba MMD regime also came up with a comprehensive National Gender Policy with the aim of mainstreaming the empowerment of women in various sectors of the economy including land ownership. The policy document, however, bemoans the fact that the empowerment of women with secure title to land for 99 years, was being hampered by customary law, that only recognizes husbands and not wives, as owners of property as per the current constitution. Such a provision leads to a situation where property (including land) is grabbed from the wife or widow by the relatives of the husband upon divorce or death (GIDD, 2000, p. 30-31).

Thus, women small-scale farmers remain vulnerable and easily become marginalized and destitute upon divorce or the death of a spouse, despite having worked the land for many years. Such marginalization undermines women's food security status as well as that of their children, because they loose the land which is the main source of livelihood.

4.3 Rebuilding the Resilience of rural society under the New Deal MMD Administration: 2001 to date.

When President Levy Patrick Mwanawasa won elections in 2001, but on an MMD ticket, he called his administration, a New Deal. The government continued to promote private sector led developments in order to achieve growth in the economy. How ever, as part of the New Deal, the government undertook deliberate measures aimed at rebuilding the resilience of small-scale farmers who had experienced both policy (SAPs) and environmental shocks (droughts and floods), in the past ten years.

This rebuilding aimed at reducing poverty by increasing food production, as well as ensuring national and household food security through the promotion of the production by small-scale farmers of cereals, legumes, roots and tubers, tree and plantation crops (GRZ,2004), as well as livestock restocking.

To achieve these objectives, the New Deal administration undertook to implement two programmes. Firstly, a partial 50% subsidy for fertilizers was re-introduced in 2002 as the Fertilizer Support Programme. The subsidy was increased to 60% by 2007. It was meant to help small-scale farmers (both men and women), that had lost income as a result of the shocks, especially the 2000/2001 drought

In the Fertilizer Support Programme, a total of 120,000 farmers were targeted by providing them with a total of 24,000 tonnes of D- Compound and 24,000 tonnes of Urea fertilizer. This deliberate intervention led to an increase in production of over 360,000 metric tonnes of maize valued at K200 billion between 2002 and 2004 (GRZ/PRSP, 2004, p.23).

Secondly, the government introduced the Food Security Pack that was targeted at the vulnerable but viable small-scale farmers. This programme was to be administered by a government supported NGO, the Programme Against Malnutrition (PAM). Under this programme, 3,140 tonnes of basal and 3,217 tonnes of Urea fertilizer was distributed, together with 50 tonnes of maize seed, and 23 tonnes of sunflower seed (GRZ/PRSP, 2004,p.23). A total of 125,000 beneficiaries per year were reached, from a targeted number of 200,000 vulnerable but potentially viable farmers (GRZ/PRSP, 2004, p.39).

In order to rebuild or strengthen further the resilience of small-scale farmers so that they can fight rural poverty, the Mwanawasa administration, with the active participation of cooperating partners or the

international community, the United Nations System and both local and international NGOs, have undertaken measures such as budget support for infrastructure rehabilitation (roads, and bridges), livestock restocking (especially in the Southern and Western Provinces), where K1.5 billion has been spent, and the fight against the HIV/AIDS pandemic.

Other measures include borehole drilling (to provide clear drinking water to rural communities especially those that were affected by droughts), fish pond construction (to promote fish farming by small holders), and the distribution of donkeys under the Animal Draught Power Programme.

In addition, small-scale farmers were trained through the Golden Valley Agriculture Research Trust (GART) and in the Heifer Project International (HPI), in dairy, sheep and goat production. Goats were purchased and distributed to resource poor farmers on a pass on the gift basis (GRZ/PRSP, 2004,p. 22-23).

In order to sustain restocking, the government resumed vaccination of animals to fight livestock diseases. A total of K3 billion was released for the purchase of animal vaccines. About 52,721 animals were vaccinated against foot and mouth disease and 6,000 were screened for trypanosomiasis (GRZ/PRSP, 2004, p.23).

Small-scale farmers were encouraged to establish improved fallow plots through additional funding for the distribution of agro-forestry tree seedlings, and the seed multiplication programme to improve food security.

The New Deal administration also reintroduced a minimum floor price for maize, if the crop was sold through the Food Reserve Agency (FRA). The agency was established and mandated to be a buyer of last resort and holder of national strategic food reserves. The minimum price stood at K38,000 per 50 kg bag of maize in the 2006/2007 marketing season. This arrangement was meant to respond to the cry by small-scale farmers that they were not benefiting from maize production, as urban based entrepreneurs who bought maize from remote areas continued to offer uneconomic prices.

In order to promote export-led growth, the Mwanawasa government also provided funding for coffee, cotton and tobacco out grower schemes. These schemes promoted commercial production of paprika, fresh vegetables, cotton, coffee and tobacco, by farmers who organized themselves into groups. Other out grower schemes are spear headed by private agri-business companies who provide inputs, credit, extension and markets to small-scale farmers on a contract-farming basis.

Although the Zambia Red Cross Society (ZRCS) reported that critical vulnerability in Zambia remains primarily due to regional imbalances in agricultural production, and the inability to transport grain from surplus areas (in the higher rainfall regions) to deficit (semi-arid or drier) areas of Southern and Western Provinces (Development Zambia, Issue no.28, July,2007), it can be argued that the totality of the intervention measures undertaken by the New Deal Administration, together with the support from the cooperating partners, the UN system and NGOs, have contributed significantly to a steady recovery of the food production system in the country.

For instance, the quantity of maize produced has increased, as well as crop diversification to broaden the food base. Whereas a total of 869,964 metric tones of maize were produced in the 2002/2003 season, the amount increased to 1,056,676 metric tones in the 2003/2004 season, an increase of 17.8% (CSO,2006a, p.6).

Despite the flooding that was experienced in the 2006/2007 agricultural season, Zambia was able to enjoy a surplus of maize, and the country exported maize to neighbouring countries such as the Democratic Republic of Congo and Zimbabwe, and made a donation of 10,000 metric tonnes to the World Food Programme (WFP) from the 2006/2007 season harvest , after meeting internal requirements.

Vulnerability assessments have indicated that some diversification in food production is taking place although maize is still the major staple. It was indicated that some positive developments have taken place in the production of cassava and sweet potatoes. The total area planted to cassava and sweet potato increased by 65% and 54%, respectively, and the production of cassava flour has more than doubled in the past ten years (ZVAC, 2005,p.10).

In the same vein, Zulu et al (2007) state that Zambian small-holder agriculture has become more diversified over the past decade, with maize, cassava, groundnuts, cotton, horticultural crops and animal products all becoming important sources of cash revenue, that can be used to purchase food on the market.

The Southern African Development Community (SADC) Food, Agriculture and Natural Resources Vulnerability Assessment Committee (SADC/VAC, 2002), indicated that in Zambia, the national cereal gap was reduced by nearly 60% by including cassava in the food balance analysis using the maize equivalent. Furthermore, cereal deficits are partially covered through informal cross-border trade.

In as far as land tenure is concerned, the Mwanawasa administration has continued to uphold the vision of the MMD of empowering citizens (men, women and the youth) with “secure, fair, and equitable access and control of land for sustainable socio-economic development…” (FNDP, 2006, p.70).

The overall goal is “to have an efficient and effective land administration system that promotes security of tenure, equitable access and control of land for the sustainable socio-economic development of the people of Zambia” (FNDP, 2006, p.70).

It is hoped that during the duration of the Fifth National Development Plan period from 2006 to 2010, a National Land Policy will be put in place to guide the governance of land, and "promote security of tenure through registration of private and communal rights" (FNDP, 2006, p.70).

As a matter of fact, the second Draft Land Policy which is being debated states that in order to advance the advantages of customary tenure practices, the government will "recognize the rights of land users by defining these rights through formal survey and registration so that every one irrespective of social status, gender or origin can have similar rights to land" (GRZ,2006,p.14).

In order to reduce vulnerability of rural society in Zambia and improve or rebuild resilience of food production or livelihood systems through secure tenure, there is need to embrace and implement the above stated intentions of empowering smallholder farmers by registering their land rights on customary land in villages.

These intentions are similar to the strategy being followed in Uganda on how to integrate statutory and customary tenure which is described by Mwebaza (1999) cited in Kajoba (2003, p.311).In the Ugandan case, there is legal provision that all citizens owning land under customary tenure may acquire a certificate of customary ownership. These certificates may be leased, mortgaged, and pledged where the customs of the community allow.

In the case of Zambia where a market and private sector driven economy is being constructed, it may be a useful way to empower rural cultivators (especially women and the youth) with more secure tenure over land by implementing a strategy where fields that are currently being tilled on customary land are registered and individuals given certificates of customary title, in the context of a dual land tenure system.

Such titles could be issued by local government institutions that include traditional rulers and their advisory councils, in some form of a decentralized system of land governance. The customary certificates of title may be leased, mortgaged, pledged and even sold, where rural land markets have emerged.

Individuals holding such customary certificates of title, may be able to rent or sell their fields if they decide to migrate to an urban centre for a long period of time, or they may lend the fields to their relatives with or without a consideration in money or in kind, as part of social capital.

Such certificates of customary title could empower the cultivators with a strong sense of ownership and control over their land, and use it more productively even by obtaining agricultural credit, while using the land as collateral.

This kind of empowerment could be greatly appreciated by women farmers, especially widows, divorced, single and even married women, who tend to be marginalized over land in most communities since customary law supercedes any other provisions intended to mitigate the plight of such women (ECA/SA, 2003; GIDD, 2005).

If women obtained certificates of customary title to the fields that they till, they could opt to remain on their land upon being widowed or divorced, or could sell their property and relocate to settle elsewhere with some income. This option could be better than what currently prevails, as they are made to become destitute after land has been grabbed away from them by former husbands or relatives of the deceased spouse, despite having worked such land for a considerable length of time.

When the certificates of customary title are being issued following registration of fields, the traditional authorities will be expected naturally, to reserve some portion of land in trust for future generations, especially for children, and others with special needs, such as orphans, the disabled, those afflicted with HIV/AIDS, the elderly and other vulnerable individuals.

In addition, land needed for development by both local and external investors could be released from such land that is held in reserve, and individuals should still be able to access common property resources such as forests, fisheries, wild game, rivers, lakes, pasture and community infrastructure like dams and boreholes.

The implementation of such an empowerment strategy could be done in phases, beginning with a pilot project, probably in an area where small-holder commercial agriculture is more developed; where pressure over land is more acute, and where demand for land and secure tenure are the generative themes among the rural people.

It may be argued that such registration and issuance of certificates of customary title, which still recognizes the place of common property resources, is a transitional step towards a gradual or evolutionary individualization of land tenure. Such a gradual approach is necessary in order to avoid alienating the traditionalists and other interest groups and because rural land markets are not yet fully developed in most parts of Zambia.

Furthermore, a gradualist approach as part of a long term vision that hopes to achieve a transformation of rural society from being agrarian based to a modern market based industrial state, is necessary. This is so because industrialization that should absorb the surplus population from rural areas, to avoid landlessness, is still quite slow in Zambia.

5.0 CONCLUSION

The paper has shown the complex interplay between vulnerability and resilience of rural society in the historical perspective. It has shown that pre-colonial ecologies of agricultural systems in some parts of Zambia, such as the *citemene* system of the Bemba (in the high rainfall zone in Northern Zambia), the cattle based system of the Tonga (in the tsetse fly free Southern Zambia) and the Flood Plain cultivation and transhumance system of the Lozi (in Western Zambia), were sustainable and resilient. This is so because they provided for the cultivation of a broad base of cereals, root crops, pulses and fruit, which ensured relative house hold food security within the context of communal land tenure.

Although these food production systems were vulnerable to environmental shocks like droughts, floods, locust invasion and livestock diseases, they were nonetheless resilient, and they ensured food security, as per the chronicles of European travelers like David Livingstone.

The imposition of colonial rule and the associated policies created mixed responses in the food production systems. While the policies of land alienation, the creation of native reserves and labour migration made the Bemba and Lozi systems vulnerable due to the loss of labour, the Tonga people were able to exhibit resilience by adapting and adopting the new methods of cultivation that were introduced by European settler farmers and missionaries.

The Tonga rapidly adopted hybrid maize, the ox-drawn plough and began to transform communal land tenure into individual holdings or tenure, in which they demanded for individual title to land, contrary to tradition.

The paper has shown further that with the attainment of political independence in 1964, the UNIP government of Dr. Kaunda made excessive interventions in order to promote agriculture and rural development. This was done by providing subsidies on maize production and by establishing an elaborate infrastructure for maize marketing, credit provision, extension, pricing and research.

This heavy intervention created dependence on maize (while other food crops were neglected), and on government, by small-scale farmers, but did not lead to food self-sufficiency that the UNIP government hoped for. Strong government control of the economy also led to protectionist land policies that constricted individual tenure but promoted communal tenure.

When the MMD government of Dr. Chiluba came to power in 1991, it introduced neo-liberal policies of privatization and agricultural market liberalization, together with a strong drive towards individualization of land tenure by popularizing conversion of communal tenure to leasehold tenure. These reforms were intended to create a market based economy that was driven by the private sector, instead of being state driven as was the case under UNIP rule.

Agriculture market liberalization removed the subsidies on fertilizers, maize marketing, transportation, storage, and state controlled pricing of agricultural commodities; and subsequently led to the collapse of marketing boards and credit institutions.

Critics of the government argue that the economic policies that were introduced by the MMD government under SAPs, led to the vulnerability of rural society and bred food insecurity and wide spread rural poverty.

The paper goes on to show however, that the New Deal, MMD administration of President Mwanawasa, has begun to make deliberate and targeted interventions, with the support of the international community or cooperating partners, the UN system and NGOs. This is being done through the reintroduction of partial subsidies on fertilizers, provision of some fertilizers and maize seeds, cattle restocking and vaccinations, the re-introduction of a minimum floor price for maize, and the provision of a market for maize and other crops through the FRA.

It is argued that these and other interventions seem to be helping in rebuilding the resilience of rural society (through crop diversification) despite continuing environmental shocks like droughts and floods. It is also contended that this emerging resilience should be strengthened further by balancing the roles of individuals, the state, the private sector and the support of cooperating partners, the U.N. system and NGOs, and by adopting a national land policy that can empower all rural cultivators (especially women and the youth). These groups need more secure land rights or tenure, in the context of an emerging market economy, but without depriving the cultivators access to common property resources, which contribute to sustained livelihoods and household food security.

REFERENCES

Adger, W. N, 2002,"Social and Ecological: resilience: are they related?" in *Progress in Human Geography*, 24, 3 pp 347-364.

Adger, W. N, 2006,"Vulnerability", in *Global Environmental Change*", 16, pp268-281.

Allan, W. et al, 1945, *Land Holding and Land Usage Among the Plateay Tonga of Mozanbuka District; A reconnaissance Survey*, Rhodes, Livingstone Institute NO.14. Manchester University Press.

Brown, T, 2005, "Contestation, Confusion and Corruption: Market-based Land reform in Zambia" in Sandra Evers, Marja Spierenburg and Hary Wels (eds.), *Competing Jurisdictions: Settling Land Claims in Africa*, Leiden Presss, Brill, pp79-107.

Bwalya, M.C, 1984, "Participation or Powerlessness: The place of peasants in Zambia's Rural Development", in Woldring, K. and Chibaye, C. (eds.), *Beyond Political Independence: Zambia's Development Predicament in the 1980s*, Mouton Publishers, Berlin.

Chabala C. and Sakufiwa, E; 1993, Small-Scale Maize Marketing and Storage in Zambia, Consulting Report for IFAD, Small-Wolder Services Rehabilitation Project, Ministry of Agriculture Food and Fisheries, Lusaka, May.

Chikulo, B,C., 1986 *Availability and Access: Food Security in Zambia*, McGill University Centre for Developing Area Studies, Discussion Paper Series, NO.34.

Chileshe, A.R., 2005 *Land Tenure and Rural Livelihoods in Zambia: Case Studies of Kamena and St. Joseph*, PhD. Thesis University of Western Cape, Southern Africa.

Chipungu, N.S.1988, *The state Technology and Peasant Differentiation in Zambia: A Case Study of the Southern Province, 1930-1986*, The Historical Association of Zambia, Lusaka.

Clarence-Smith, W.G.1979,"Slaves Commoners and Landlords in Bulozi 1875 to1906," in *Journal of African History*, 20, NO.2, pp219-234.

Coillard, F; 1897, *On the Threshold of Central Africa*, Translated by Mackintoch, CW, Hodder and Stoughton London

Coleman, G., 1983, Labour Migration Labour Availability and Agriculture Change in Barotseland (Western Province) Zambia, University of East Anglia Development Studies discussion Papers NO.135, July

Conroy, D.W.1945,"Legal Aspect of Land Holding Among the Plateam Tonga", in Allan, W. et al, *Land holding and Land Usage Among the Plateam Tonga of Mazabuka District: A Reconnaissance Survey*, Rhodes-Livingstone Institute, NO.14, Manchester University Press, pp89-120.

C.R.C. 2005, *Constitution Review Commission: Summary of Public Comments of the Interim Report and Draft Constitution and Reactions of the Constitution Review Commission* (CRC), Lusaka, 29th December, Government Printer.

Crehan, K, 1983, "Women and Development in North-Western Zambia: from producer to housewife", in *Review of African Political Economy*, NO.27/28, pp51-66.

CSO, 2006, *Selected Socio-Economic Indicators 2003-2004* Central Statistical Office (CSO), Lusaka, January.

CSO, 2006a, *Agricultural Production Post Harvest Data for small and Medium Scale Farmers*, Central Statistical Office (CSO), Lusaka, May 16.

Eakin, H. and Luers, A.M., 2006, "Assessing the Vulnerability of Social- Environmental Systems," in *Annual Review of Environment and Resources*, Vol.31, July 18. pp365-394.

ECA/SA, 2003, *Land Tenure Systems and Sustainability Development in Southern Africa*, Economic Commission for Africa, Southern Africa Office, Lusaka.

Eklund, P., 1985, *The Lima crop Extension Programme Evaluation, Strategy and Indicative Plan, 1986-90*, Special Study Report NO.8, Ministry of Agriculture and Water Development, Planning Division, June. Lusaka.

FAO, 1996, *Rome Declaration on World Food Security and World Food Summit Plan of Action*, Food and Agricultural Organisation (FAO), Rome, November, 13-17.

FNDP,2006, *Fifth National Development plan 2006-2010*,Ministry of Finance and National Planning, Lusaka.

GIDD,2000, *National Gender Policy*, Gender in Development Division (GIDD), Cabinet Office, Lusaka, March.

GIDD,2005, *Baseline Survey on Women's Access to Agricultural Land in Zambia —Research Report*, Gender in Development Division (GIDD), Cabinet Office, Lusaka.

Gilks, P. 1975, *The Dying Lion: Feudalism and Modernization in Ethiopia*, Julian Friedmann Publishing, Ltd, London.

Gittinger, J.P.1990, *Household Food Security and the Role of Women*, World Bank Discussion Paper No.96

Gluckman, M.1968, *Economy of the Central Barotse Plain*, Rhodes, Livingstone paper's Number Seven, (Second Impression), for the Institute for Social Research/ African Studies, University of Zambia, Manchester University Press.

Gluckman, M.1969, "Property Rights and Status in African Traditional Law" in Gluckman, M. (ed.), *Ideas and Procedures in African Customary Law*, Oxford University Press.

Gouldsbury, C, 1911, *The Great Plateau of Northern Rhodesia*, Edward Arnold, London.

GRZ, 2006, *Draft Land Administration and Management Policy*, Ministry of Lands, Lusaka

GRZ, 1983, *Economic Report*, National Commission for Development Planning, Office of the President, Government Printer, Lusaka.

GRZ, 2004; *National Agricultural Policy 2004-2015*, Ministry of Agriculture and Cooperative, Lusaka, November.

GRZ/PRSP, 2004, *Zambia First Poverty Reduction Strategy Paper Implementation Progress Report, January 2002-June2003*, Ministry of Finance and National Planning, Lusaka, March.

Hallen, J.A; 1968, *Rural Economic Development in Zambia 1890-1964*, Weltforum Verlag Munchen.

Howard, R, 1980," Formation and Stratification of the Peasantry in Colonial Ghana", in *The Journal of Peasant Studies*, Vol. 8, No.1. October.

IFAD, 1995, *Common Property Resources and the rural Poor in Sub-Saharan Africa*, International Fund for Agricultural Development (IFAD), Amsterdam.

July, R. 1975, *Pre-Colonial Africa*, Charles Scribner's Sons, New York.

Kajoba G. M., 1993 *Food Crisis in Zambia*, Zambia Publishing Company, Lusaka.

Kajoba G. M; Volk, J. Nge'nda, G; and Mwanza, A; 1995,"Sustainable Management of Village Resources and Encroaching Commercialisation in Mumena, Solwezi District, North Western Zambia", *Main Research Report*, to the African Development Foundation(ADF), of Washington D.C; November-December, Lusaka

Kajoba G. M;, 1998, "The Landmarks of Zambia's land tenure system: From Protectionism to Empowerment", in Barry, E. (ed.), *Proceedings of the International Conference on Land Tenure in the Developing World with a focus on Southern Africa*, University of Cape Town, 27-29 January, 1998, pp. 300-310.

Kajoba G. M, 1998a,"The Impact of the 1991/92 Drought in Zambia in Ahmed, A.G.M. and Mlay, W. (eds)," *Environment and Sustainable Development in Eastern and Southern Africa: Some Critical Issues* , MacMillan Press Ltd. in Association with OSSREA, pp. 190-206.

Kajoba G. M, 2002,"*Land use and Land Tenure in Africa: Towards an evolutionary conceptual framework*," Paper Presented at the workshop on Agricultural Sustainability in Africa, organised by CODESRIA-IFS Kampala, Uganda, 14–17 December.

Kajoba G.M, 2003, "Land and Natural Resources Tenure Reform in Developing Countries: Lessons for Zambia", in V.C. Jha (ed.) *Land Degradation and Desertification*, Rawat Publishers, Jaipur and New Dehli, pp291-319.

Kalapula, E.S; 1984, *Back to the Land: Youth- Based Agricultural Land Settlement Centres for Economic and Social Development in Southern Zambia*, PhD Thesis, Clark University, U.S.A.

Kalapula, S.C; 2007, *The Socio-Economic Impact of Theileriosis (East Coast Fever) or Corridor Disease on the Livelihood of People of Namwala District: A Case Study of Baambwe Area*, Project Report, Department of Geography, The University of Zambia, Lusaka.

Kalinda, T.H; 2002, "Agriculture and food Security in Zambia", in *African Social Research*, Number 43/44, University of Zambia Institute of Economic and Social Research, pp61-78.

Kaunda,K D;1968, *Humanism in Zambia and a Guide to Its Implementation*, Part I, Zambia Information Services, Lusaka.

Kaunda,K D; 1974,*Humanism in Zambia and a Guide to Its Implementation*, PartII, Division of National Guidance, Lusaka.

Kay, G. 1964, *Chief Kalaba's Village*, The Rhodes-Livingstone papers No. 3 Manchester University Press.

Kapungwe, A.2003,"Poverty Situation in Zambia(1990-2000)", in Chileshe, J.D. et al (eds.), *First Annual Poverty Review Conference in Zambia 2002 Proceedings*, Zambia Social Investment Fund(ZAMSIF) Lusaka. 25th-26th March, pp21-47.

Keller, B. and Mbewe, D, 1988, *Impact of present Agricultural Policies on the role of Women, Extension and Household food Security*, Paper presented at the Workshop on Strategies for Implementing National Policies in Extension and Food Security, Itezhi-tezhi, Dec. 8-10, Planning Division, MACO, Lusaka.

Keller, B; Phiri, E.C. and Milimo, M.C. 1990,"Women and Agricultural Development", in Wood, A.P. et al (eds.), *The Dynamics of Agricultural Policy and Reform in Zambia.* Iowa State University Pres, AMES, pp241-262.

Kodamaya, S, 2007, "Vulnerability and Coping Strategies in Africa: Literature Review for Research in Zambia", in Umetsu, C. (ed) *Vulnerability and Resilience of Social-Ecological Systems Project Report*, No.3, Research Institute for Humanity and Nature, March, pp35-43.

Langworthy, H.W; 1972, *Zambia before 1890: Aspects of Pre-colonial History*, Longman Group Limited, London.

Livingstone, D, 1857, *Missionary Travels and Researches in South Africa*, Clowes and Sons, London.

Lombard, C.S.and Tweedie, A.H.C; 1972, *Agriculture in Zambia since Independenc*e, NECZAM.

Manuh,T, 1989,"Women, the Law and Land Tenure in Africa", in Rathgeber, E.M. and Kettel, B.(eds.), *Women's Role in Natural Resources Management in Africa*, IDRC, Canada, October, pp26-40.

Mbulo, M.P, 1985,"Settlement Schemes and Food Production in Zambia", in Osei-Hwedie, K. and Ndulo, M.(eds.), *Issue's in Zambian Development*, Omenana, Roxburg, U.S.A, pp129-149.

Milimo, M.C.1987, "Women, Population and Food in Africa: The Zambia Case", in *Development: Journal of the Society for International Development*, 2/3, pp70-83.

Moore,H,and Vaughen, M.,1987,"Cutting down Trees: Women Nutrition and Agricultural Change in the Northern Province of Zambia, 1920-1986", in *African Affairs*, Vol.86, NO.345, October, pp523-540.

Moore, H. L. and Vaughen, M.,1994, *Cutting Down Trees : Gender, Nutrition, and Agricultural Change in the Northern Province of Zambia, 1890-1990*, Heineman, Portsmouth and University of Zambia Press, Lusaka.

Mulungushi, J.S., 2003, "Poverty Reduction Strategy Paper for Zambia: Government Perspective", in Chileshe, J.D. et al (eds.), *First Annual Poverty Review Conference in Zambia, 2002 Proceedings*, Zambia Social Investment Fund(ZAMSIF), Lusaka, 25th-26th March, pp74-82.

Muntemba, M.S,1980,"Regional and Social Differentiation in Broken Hill Rural District Northern Rhodesia, 1930-1964", in Klein M.A.(ed.), *Peasants in Africa: Historical and Contemporary Perspectives*, Sage Publishers, London.

Mwanaumo, A., 1974, *The Effects of Maize Marketing Policy Reforms in Zambia*, PhD, Thesis Purdue University.

Mwefyeni, E.C; 2003 *Impact of Agricultural Market Liberalisation on Demand for Maize in Zambia*, University of Zambia Project, School of Agriculture, Lusaka.

Mvunga, M.P.1980 *The colonial Foundations of Zambia's Land Tenure System*, NECZAM, Lusaka.

Ncube, P.D.,1983, "The Zambia Food Strategy-Aspects of Production" in Ncube, P.D.(ed), *Agricultural Baseline Data for planning*, National Commission for Development Planning and the University of Zambia, Vol.1. July. Lusaka.

Njobvu, C.A. and Shawa, J.J. 1996, *Small-holder Farming and Agricultural Credit under Structural Adjustment Programme in Zambia*, The Study Fund Committee Social Recovery Project, Lusaka, November.

North, A.C. et al; 1961, "African Land Tenure Development in Kenya and Uganda and their application to Northern Rhodesia", in *Journal of African Administration*, Vol.13, No.4, October, pp211-219.

N.R.G/Zambia, 1930, *Native Affairs Annual Report*, Government Printer, Lusaka.

Nyanga, P.H. 2006, *Impact of Agricultural Policy Change on Household food Security among Small-Scale Farmers in Southern Zambia*, M.A. Dissertation, Norwegian University of Life Sciences, Department of International Environment and Development Studies.

Palmer, R. 1973, "Land in Zambia" in Palmer, R.(ed.)*Zambia Land and Labour Studies*, Vol.1, National Archives Occasional Paper No.17, May.

Peters, D.U.1960, *Land Usage in Barotseland*, the Rhodes-Livingstone Institute, Communication No.19.

Priestly and Greening, 1956, *Ngoni Land Use Survey*, 1954-1955, Government Printer, Lusaka.

Pritchard, J.M. 1979, *Africa: A Study Geography for Advanced Students*, Harlow Longman Group, Revised Third Edition.

Richards, A.1939, *Land, Labour and Diet in Northern Rhodesia: An Economic Study of the Bemba Tribe*, Oxford University Press.

Roberts, A.D.1976, *A History of Zambia*, Heinemann, London.

SADC/VAC, 2002, *SADC Regional Food Security Emergency Assessment Highlights*, Southern African Developments Community Food, Agriculture and Natural Resources Vulnerability Assessment Committee (SADC/VAC), Lusaka.

Schultz, J. 1976, *Land Use in Zambia*, Munchen Weltforum Verlag.

Scudder, T. 1962, *The Ecology of the Gwembe Tonga*, Manchester University Press.

Selous F.C. 1893, *Travel and Adventure in South-East Africa*, Rowland Ward and Co. Ltd, London.

Sharpe, B; 1990, "Nutrition and the Commercialisation of Agriculture in the Northern Province", in wood A.P. et al (eds.) *The Dynamics of Agricultural Policy and Reform in Zambia*, Iowa state University Press, Ames, pp583-602.

Siddle, D.J; 1971, "Cooperatives" in D. Hywel Davies (ed.) *Zambia in Maps*, University of London Press, Ltd.

Tabler, E.C. (ed.), 1963, *Trade and Travel in Early Barotseland*, Chatto and Windus, London.

Tiffen, M, and Mulele, R., 1994, *The Environmental Impact of the 1991-92 Drought on Zambia*, The World Conservation Union (IUCN), Gland Switzerland and Lusaka, Zambia.

Trapnell, C.G. and Clothier J.N, 1937, *The Soils, Vegetation and Agricultural Systems of North Western Rhodesia: Report of the Ecological Survey*, Government Printer, Lusaka.

Trapnell, C.G.1953, *The Soils, Vegetation and Agricultural Systems of North Eastern Rhodesia: Report of the Ecological Survey*, Government Printer, Lusaka.

Van Horn, L.,1977, "The Agricultural History of Barotseland, 1840-1964", in Palmer, R. and Parsons, N.(eds.) *The Roots of Rural poverty in Central and Southern Africa*, Heinemann, London, pp144-169.

White, C. M.N, 1959,"A Survey of African Land Tenure in Northern Phodesia", in *Journal of African Administration*, Vol.11, No.4, October, pp171-178, Part one.

White, C. M.N,1960,"A Survey of African Land Tenure in Northern Rhodesia", in *Journal of African Administration*, Vol.12, No.1,January, Part Two, pp3-10.

WLSA, 2001, A *Critical Analysis of Women's Access to Land in the WLSA Countries*, Women and Law in Southern Africa Research Trust (WLSA), Harare.

Woldring, K.,1984 "The Rural Malaise in Zambia: Reflections on the Rene Dumont Report and the State Farms Project "in Woldring, K and Chibaye, C.(eds.),*Beyond Political Independence : Zambia's Development Predicament in the 1980s*, Mouton Publishers, Berlin, pp95-111.

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Sub-Theme IV-1: Global Monitoring on the Environmental Change

- Meteorological observations in Southern Province of Zambia -

Tazu Saeki (Research Institute for Humanity and Nature)

1. Introduction

Precipitation is an important forcing to modulate the Zambian ecological environment and its variability has an impact on rural households. In the Sub-Theme IV-1 we investigate the climatorogical/meteorological changes, in and around Zambia from a view of two spatial scales, that is, a continent-country scale and a province-district scale. We focus mainly on the two following objectives:

i) To Analyze of archived global meteorological data sets to identify meteorological characteristics of Zambia and to investigate temporal and spatial precipitation variabilities on a continent-country scale.

ii) To compile and analyze of rain-gauge based data sets to get better understanding precipitation variability on a province-district scale and to identify the time and geographical extent of “meteorological” drought.

Based on field research in the pre-research year (FY2006), we have planned to install weather-monitoring sensors in Southern and Eastern Provinces of Zambia to monitor local meteorological conditions of the research fields. In September 2007 two weather stations and rain gauges have been installed in Southern Province. Ground-based meteorological data were also collected for the objective ii above. This report outlines the observations and obtained ground-based data.

2. Installation of meteorological equipment in Sinazongwe area

With cooperation from members of the other themes and Zambian counterparts in Mt. Makulu Central Research Station, Zambian Ministry of Agriculture and Cooperatives (ZARI), 2 weather stations and 48 rain gauges have been installed in Sinazongwe area of Southern Province in September 2007 and at work since then. Sinazongwe area (Sinazongwe and Choma districts) is located in agro-ecological zone I where receives less than 800mm of annual precipitation and is ecollogically vulnerable. Villagers in this area have been also affected by social and historical events like construction of Kariba dam. Accordingly, Sinazongwe area was chosen as one of main research fields of Resilience Project.

2.1 Weather stations

Among five villages at which Theme 2 household survey has been conducted in Sinazongwe

area, we selected two villages as weather monitoring sites in terms of topography and the surroundings. The selected sites are Siachaya and Sianemba which are located at the top and the foot of a slope in Sinazongwe area, respectively. Weather stations were installed at each site to monitor weather conditions at top and bottom of the slope. Outline of the site are summarized in Table 1 and Figure 1. At this stage the weather stations observe six meteorological parameters; temperature, humidity, wind speed and direction, solar radiation, precipitation, and pressure. Components of the stations are listed in Table 2. The two stations have the same specification except for calibration factors of the pyranometors.

2.2. Rain gauges

As a part of Theme 2 household survey, 48 sets of rain gauges and loggers were installed at the five villages in Sinazongwe area to monitor local precipitation received to farmers' crop fields. The numbers of installed rain gauges were 16 at Siachaya (upper slope area), 8 at Chanzika and at 8 at Kanego (middle slope area), 4 at Siameja and 12 at Sianemba (lower slope area). The detailed of installation locations would be described elsewhere. Rain gauge stands were manufactured by a steel factory in Lusaka (Fig. 2a). The stand was settled under the ground in the crop field with cement and a 0.5 mm tipping bucket rain gauge was set on it with a logger insede (Fig. 2b). The log interval was set to be 30 minutes.

3. Ground-based meteorological data in Zambia

The Zambia Meteorological Department (ZMD), Ministry of Communications and Transport have observed meteorological elements at dozens of stations which cover wide geographical area in Zambia. In this September we obtained ZMD meteorological data set on a monthly basis at 40 ZMD stations. The obtained ZMD station specification and observed elements at each station are summarized in Tables 3a and 3b. The data analysis remains further research.

Besides ZMD stations, there are lots of local voluntary stations. Observed data at such voluntary stations have not been compiled by ZMD. These stations may cover unobserved area by ZMD, hence it is worthwhile to look for such data to get knowledge of rural environmental conditions. Owing to Dr. Matsumura, a member of theme IV, we got precipitation data at Maamba and Sinazongwe in this September. These stations are close to the research fields, which data may help us to know historical record of precipitation.

4. Summary and outlook for the next fiscal year

We set up the meteorological observations in Sinazongwe area and plan to carry out the observations during the full research years of the resilience project. The observed data will be provided to other themes as fundamental ecological data to analyze socio-ecological resilience. We also start to collect local meteorological data sets in Zambia.

In the next fiscal year Sub-Theme IV-1 will propose:

- ✓ to maintain the installed equipment with the project members,
- ✓ to collect further meteorological data over Zambia,
- ✓ to analyze the global meteorological data and ground-based data in focus on Zambia and to identify the timing and geographical extent of meteorological drought.

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(a) (b)

Figure 1 Installed weather stations at (a) Siachaya and (b) Sianemba.

(a) (b)

(Photo by Chieko Umetsu)

Figure 2. (a) Rain gauge stands and (b) installation of a rain gauge.

Table 1. Outlines of two weather monitoring sites in Sinazongwe area

Village	Siachaya (Upper Slope)	Sianemba (Lower Slope)
Name of station	Luwo Siachaya	Luwo Sianemba
Place	Old field next to a headman's house	Clear space between houses near headman's
Location	S 16˚98025' E 027˚33947' 1091 m a.s.l.	S 17.08714˚ E 027.52253˚ 511m a.s.l.
Starting date of monitoring	2007.9.14	2007.9.13
Monitoring interval	Every 30 min	Every 30 min
Calibration factor of pyranometor	16.31	16.58
Uploaded program	FIELD_South1631.CR1	FIELD_South1658.CR1

* "Luwo" means "wind" in Tonga.

Table 2. Components of the meteorological stations

Category		Manufacturer/Model number or Specification
Sensor	Temperature and humidity measurement probe	Campbell Scientific Inc./ CS215-L6
	Wind speed and direction sensor	Campbell Scientific Inc./ 034B-L11
	Pyranometer	Kipp&Zonen/ P-CMP3 Prede Co.
	Rain gauge	Campbell Scientific Inc./ TE525MM-L25
	Barometric pressure sensor	Campbell Scientific Inc./ CS115
Logger	Datalogger	Campbell Scientific Inc./ CR1000-XT
peripherals and related equipment	Solar panel 20W	Campbell Scientific Inc./ MSX20, SP20
	12V Battery	Campbell Scientific Inc./ PS100
	Enclosure	Campbell Scientific Inc./ ENC16, 16-TN
	Compact flash card slot	Campbell Scientific Inc./ CFM 100, 100-XT
	Shade	Campbell Scientific Inc./ 41303-5A
	Solar radiation sensor mount	Campbell Scientific Inc./ CM225
Related hardware	Main pole	Pype 42.8mmØ
	Sub pole	Pype 25mmØ
	Raingauge stand	Pype 25mmØ
	Brace	Angle 40x40x3mm
	Joint	Galaken Co./ DM3882

Table 3a. Locations of meteorological stations of ZMD

CLICOM ID	LAT DG	. MN	LON DG	G. MN	ELEV. (m)	STATION NAME
'CHIPAT01'	13	33	32	35	1032	CHIPATA MET
'CHIPEP01'	16	80	27	83	0	CHIPEPO MET
'CHOMA001'	16	51	27	4	1267	CHOMA MET
'ISOKA001'	10	10	32	38	1360	ISOKA MET
'KABOMP01'	13	36	24	12	1075	KABOMPO MET
'KABWE001'	14	25	28	29	1165	KABWE MET
'KABWE002'	14	24	28	30	1207	KABWE AGROMET
'KAFIRO01'	12	36	28	7	1243	KAFIRONDA AGROMET
'KAFUE001'	15	46	27	55	987	KAFUE POLDER
'KALABO01'	14	57	22	42	1053	KALABO MET
'KAOMA001'	14	48	24	48	1152	KAOMA MET
'KASAMA01'	10	13	31	8	1384	KASAMA MET
'KASEMP01'	13	32	25	51	1134	KASEMPA MET
'KAWAMB01'	9	48	29	5	1324	KAWAMBWA MET
'LIVING01'	17	49	25	49	986	LIVINGSTONE MET
'LUNDAZ01'	12	17	33	12	1143	LUNDAZI MET
'LUSAKA01'	15	25	28	19	1252	LUSAKA CITY AIRPORT
'LUSAKA02'	15	19	28	27	1154	LUSAKA INT. AIRPORT
'LUSITU01'	16	18	28	82	392	LUSITU MET
'MAGOYE01'	16	8	27	38	1018	MAGOYE AGROMET
'MANSA001'	11	6	28	51	1259	MANSA MET
'MANSA002'	11	6	28	51	1259	MANSA AGROMET
'MBALA001'	8	51	31	20	1673	MBALA MET
'MFUWE001'	13	16	31	56	570	MFUWE MET
'MISAMF01'	10	11	31	13	1535	MISAMFU AGROMET
'MKUSHI01'	13	60	29	80	1250	MKUSHI MET
'MONGU002'	15	15	23	9	1053	MONGU MET
'MPIKA001'	11	45	31	26	1402	MPIKA MET
'MSEKER01'	13	39	32	34	1025	MSEKERA AGROMET
'MTMAKU01'	15	33	28	15	1213	MT. MAKULU AGROMET
'MUMBWA01'	14	59	27	4	1218	MUMBWA MET
'MWINIL01'	11	45	24	26	1363	MWINILUNGA MET
'NDOLA001'	13	0	28	39	1270	NDOLA MET
'PETAUK01'	14	15	31	17	1036	PETAUKE MET
'SAMFYA01'	11	21	29	32	1172	SAMFYA MET
'SENANG01'	16	7	23	16	1027	SENANGA MET
'SERENJ01'	13	14	30	13	1384	SERENJE MET
'SESHEK01'	17	28	24	18	951	SESHEKE MET
'SOLWEZ01'	12	11	26	23	1333	SOLWEZI MET
'ZAMBEZ01'	13	32	23	7	1078	ZAMBEZI MET

Table 3b. Meteorological elements observed at ZMD stations.

ID	Average Temperature	Cloud cover	Dewpoint	Evaporation	GRND_M_T	Humidity	Maximum temperature	Minimum temperature	Pressure	Rainfall	Soil moisture (5m)	Soil moisture (10m)	Soil moisture (20m)	Soil moisture (30m)	Soil moisture (120m)	Sunshine	Wind speed
'CHIPAT01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'CHIPEP01'	x					x	x	x		x							x
'CHOMA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'ISOKA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KABOMP01'	x	x	x		x	x	x	x		x	x	x	x	x	x		x
'KABWE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KABWE002'	x	x	x		x	x	x	x		x	x	x	x		x	x	x
'KAFIRO01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KAFUE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KALABO01'	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
'KAOMA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KASAMA01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KASEMP01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'KAWAMB01'	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x
'LIVING01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUNDAZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSAKA01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSAKA02'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'LUSITU01'	x		x			x	x	x									x
'MAGOYE01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MANSA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MANSA002'	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MBALA001'	x	x	x			x	x	x		x							x
'MFUWE001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MISAMF01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MKUSHI01'	x		x			x	x	x		x							x
'MONGU002'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MPIKA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MSEKER01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MTMAKU01'	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
'MUMBWA01'	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
'MWINIL01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'NDOLA001'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'PETAUK01'	x	x	x	x	x	x	x	x		x	x	x					
'SAMFYA01'	x	x	x		x	x	x	x	x	x	x		x		x		x
'SENANG01'	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
'SERENJ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'SESHEK01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'SOLWEZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
'ZAMBEZ01'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Total	40	36	38	31	36	40	40	40	31	39	36	35	35	33	35	32	40

IV-3 Research Theme: The Early Warning System and Food Security

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1. Main Aims of the research

In order to identify and clarify the crucial factors which are likely to lead the devastated situation of food insecurity in Zambia, this research will focus on the "early warning system" of drought preparedness and food crisis. In particular, instead the early analysis based on the conventional data collection, the alternative analysis that attempts to examine the political and social causes of food insecurity seems to be one of the key factors to understand the resilience of the rural society to food crisis.

2. Abstracts of the research

The purpose of our research in FY2007 is to analyse political and social elements which lead to food crisis and social vulnerabilities in Africa, especially focusing on the history of famine and food relief programme in Zambia. The research on literatures and documents written about the famine and food relief in Zambia suggests that there is a historical variety of causes of famine and long history of food relief programme to assist the famine affected area. The case study of the recent drought in 2005/06 indicates that several different agencies engaged with their relief programmes based on their own standards about vulnerability of rural people.

3. History of Famine in Zambia

3.1 Early history of famine in 19th century

Zambia has a long history of famine. A Zambian Historian, Bennett Siamwiza reveals the historical process of famines and their different causes (Siamwiza, 1998). First record of famine in Zambian history was the one during 1823-31, which was reported as a worst and most prolonged famine and Lower Zambezi valley and Eastern and Northern provinces affected by it. Subsequently, rural Zambia and neighboring areas were affected by several famines as below:

1860-63: Zamia and, Central and Southern Africa.
1877-78: Central province and middle Zambezi valley.
1882-83(84): Most of Western and Southern Province.
1885-89: Northern, North-Western, Southern and Western Province.

(1885-86: North-Western Province, 1886-87: Western Province)

In 19th century, the causes of those famines were mainly related to drought and violent incidents such as cattle and slave raiding, and ethnic conflicts. For example, in 1860/61, Kololo raided Tonga, Toka, and Subiya for cattle from fringes of Victoria fall in the south to noeth of Kafue river. At that time, over 20,000 cattle were reportedly raided. Famine in 1985/86 may illustrate the link famine and slave raiding; in the Gwembe valley people were attacked by Chikunda slavers, and in North-Western Province, Luvale slave raiders worsened the famine situation.

In those days, local people had a considerable knowledge about famine foods. For example, it was reported that Gwembe Tonga knew about more than 30 kinds of famine foods such as grass, plant seeds, roots, tubers, and fruits. At the same time, some chiefs kept reserves against famine by exacting tribute from their followers or by tribute in kind. For example, in Bemba, anybody in need could get food in two open royal gardens. In Gwembe valley, first chief Mweemba had a grain stock against famine by building large granaries in each village.

3.2 Famine in 20th century

In 20th century, early colonial period, several famines were reported as below:

1903: Eastern Province.
1905-06: Northern and Southern Province.
1908-09: Central, Eastern, Northern Southern Province and Luapula.
1912-13: Northern and Southern part of Luapla, Northern, Central and Southern Province.

The causes of famines during those years were explained by colonial authorities in terms of “Euro-centric” view, attacking mainly African’s ways of cultivation and their “improvidence”. Some records, however, referred to the colonial administration itself such as tax collection and enforced labour could undermine the people’s coping capacity against famine. In the time of 1890-1920, violence became less while natural disasters became very important.

In the early colonial period, some colonial relief efforts were made by some missionaries. The first missionary effort of relief was conducted by White Fathers among Bemba during 1894-95. They gave food and took into their custody some Bemba children. At the time of 1909 famine in Southern Province, Chikuni Mission priests employed crowds of women and girl, and had boys and young men to work in the fields in return for food. In the Gwembe Valley, during the 1908-09, a considerable amount of grain was distributed by missionaries on behalf of the administration to relieve the distress. Those

relief operations at that time were severely limited because of transport problem. Other relief policy in the Gwembe encouraged a labour migration. Native Commissioner advised old men to send their youths to the mines.

In the following periods, Zambia had a wartime famine during 1914-18 and several famines. In addition to the drought in 1915-16 and Spanish influenza in 1918, conscription into the army and provision of food to them led to food scarcity in Zambia. The following list is famines occurred mainly in Gwembe valley and their main causes.

1914-18: wartime famine.
1922: caused by 1921-22 drought and socio-economic breakdown of the communities.
1931-33: caused by drought, locusts, and growing problem of landlessness, lack of wage employment and failure of trade entitlements.
1942: continuous rainfall shortage since 1934.
1947, 1949: drought and crop fail.

On July 1931, the government started the largest relief operation in Gwembe valley. The 1942 famine was caused by great scarcity of rain and serious food shortage. The period during 1940-41 has been remembered as a season when rain fell on only one day. At that time, many men reacted to poor harvests by increasingly taking up wage employment. Over 30,000 Africans were employed on the copper belt mines alone. Agricultural production fall in 1940-41 was coincided with increased grain consumption especially railway belt area. At that time, the government imported grain on a large scale from South Africa and Belgian Congo for the first time.

In 1949, food relief depended more on cassava-growing area. Each Native Authority had a main responsibility of the food relief normally through commercial channels. Headman was allowed to buy his quota and bear responsibility for sub-dividing it among the families.

During the period of 1920-1949, indigenous economies and their coping strategies became weakened by local authorities' relief and Maize Control Board. Central, Eastern, Southern, and Western Province increasingly suffered famine because of land shortage, landlessness by alienation and the creation of African reserves.

4. A Case Study of 2004/05 Drought and Relief Programme in Sinazongwe

4.1 Food crisis in Sinazongwe, 2004/05

Sinazongwe District in the Southern Province of Zambia lies in the Zambezi valley with a hilly terrain and encompasses the upper half of the Lake Kariba shore. In Sinazongwe District, planting rains stated early December 2004 for the 2004/05 season over most areas,

but it was below normal to sustain crop growth and development. Sinazongwe District Disaster Management Committee (DDMC) appealed that on average 75% crop failure was experienced in most parts of the district with some areas such as Siameja, Syampondo and Kafwambila and Chiyabi experienced over 80% crop failure, and that the camps to the southern end of the District were the worst affected due to low rainfall recorded below 190mm (DDMC, 2005). Table 1 reflects rainfall reduction of 530.0 mm from 2003/2004 season to 2004/2005 season. This reflects a drop of about 66% in rainfall from the previous season. As a result, the 2004/2005 farming season crop production and productivity was poor to very poor for most crops (Table 2).

Table 1: Climatic indicators (Rainfall data)

Season	Month & Rainfall amount (mm)						Accumulative total (mm)
	Oct	Nov	Dec	Jan	Feb	March	
2002/2003	9.0	44.7	48.0	31.7	99.3	196.8	429.5
2003/2004	35.1	85.1	118.1	139.0	180.5	245.4	803.2
2004/2005	2.5	13.4	100.6	104.4	29.4	22.9	273.2

Source: Ministry of Agriculture and Co-operatives (MACO) Sinazongwe District (2005)

Table 2:2004-2005 Crop Production Estimates

CROP	AREA PLANTED (ha)		PRODUCTION (in metric tones)		Yield (ton/ha)	SALES (in metric tones)		RETENTION (in metric tones)	
	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005
Maize	3,125	3,100	2,550	868	0.28	6.74	2.3	2,543	866
Sorghum	2,998	2,420	2,055	774	0.32	0	0	2,055	774
Ground nuts	691	200	142	14.4	0.07	3.75	0	138	14
Cowpea	701	950	732	68.8	0.07	0	0	732	69
Soybeans	0	150	0	0	0.00	0	0	0	0
Mixed beans	495	150	46	0	0.00	0	0	46	0
Sunflower	205	100	28	4	0.04	25	4	3	0
Cassava	300	40	530	41.6	1.04	0	0	530	42
Sweet potatoes	190	200	142	32	0.16	30	0	112	32
Cotton	4,035	4,000	2,393	2,000	0.50	2,393	2,000	0	0
Millet	981	1,100	179	79.2	0.07	0	0	179	79
TOTAL	**13,721**	**12,410**							

Source: Ministry of Agriculture and Co-operatives (MACO) Sinazongwe District (2005)

4.2 Food Relief Programme in Sinazongwe 2005/06

According to estimates done by Sinazongwe DDMC, the amount of food being sought was 942.84 metric tones per month for 17,460 households (78,570 people) targeted and received only 421 metric tones food for May 2005, September 2005, November 2005, April 2006 and May 2006 from DMMU-OVP. The targeted beneficiaries in the appeal were elderly (aged), female headed households, child headed households, households keeping orphans, terminally ill headed households and food for work. Other emergency appeals were made by GTZ, Red Cross Society, Churches Council In Zambia and Maamba Catholic Parish.

Table 3 shows that several agencies engaged in food relief programme all over the district under the DDMC coordination. Each agency had its own policy and target against food crisis. For example, while GTZ mainly focused on conservation faming and training, government programme (DMMU-OVP) was targeted on food distribution to vulnerable household (20%) and food for work (80%). Although it is hard to assess their impact and effect on drought affected community, some camp officer said that the training of conservation farming did not have a good reputation among local people. We are going to examine how those food relief programmes are planed and implemented by different agencies and how local people perceive their activities.

5. Research Summary and Further Issue

In FY2007 research, we focused on the historical change of famine, the causes and the social responses in Zambia. It reveals that drought was not only a reason for famine, but some political and social affairs such as scarcity workforce during wartime and mine development could lead to food crisis. At the same time, while food relief efforts was made since 19th century by local people, government and missionary had a important role of in early 20th century. A case study of food crisis in Sinazongwe of 2005/06 indicates that nowadays several different agencies engaged in food relief programme based on their own standard.

Our research issue in FY2008 will be a detail study about those activities and their impact on local communities. By interviewing NGO stuffs, camp officers and local farmers, we try to investigate the food relief programmes and the local response to them. Through the research, we are expecting to reveal the social and political impact of early warning and disaster management activities on the resilience of local communities.

Table 3: Emergency Food Relief Programmes in Sinazongwe District

SN.	Relief programme	Starting dates	Closing dates	Objectives	Plan of action	Associated programmes	Total number of beneficiaries	Type of aid	Quantities of aid distributed	Comment
1.	DMMU-OVP	May 2005	May 2006	To provide food relief to food insecure households affected by 2004/2005 partial drought	20% Food aid provision to vulnerable households. 80% Food for work projects.	Food for assets programme. Ferrying sand, stones for Muziyo clinic, moulding & ferrying bricks for school toilets, road maintenance, collecting stones, sand & ferrying bricks for classroom construction, VIP pit-latrine construction schools & clinics, teacher's house construction	7,928 people – May 2005 12,500 people – September 2005 4,602 people – November 2005 2,500 people – April 2006 6,917 people – May 2006	Food aid: sorghum grain, maize grain & maize meal	100 MT sorghum grain – May 2005 150 MT maize grain – September 2005 58 MT maize grain – November 2005 30 MT maize grain – April 2006 83 MT maize meal– May 2006	Covering all 12 wards in the District
2.	GTZ Emergency Food Aid Relief Programme	September, 2005	January, 2006	To provide seed relief and conservation farming knowledge while providing food relief to households affected by the 2004/2005 drought	Conservation farming (CF) in combination with Food (80%). Free food aid (20%)	Seed relief (OPV seed maize, sorghum, cowpeas and cassava cuttings) CF training & Practice	2,400 households food for work 611 vulnerable households	Seed aid: OPV maize, cowpea, sorghum & cassava. Food aid: maize grain & maize-cassava mix.	150 MT maize grain 75 MT maize-cassava meal mix 12 MT maize seed, 6 MT sorghum seed, 6 MT cowpea seed & 6,192 bundles x 50 x 1metre cassava cuttings	Covering only 7 wards (Maamba, Mweemba, Tekelo, Mweenda, Mabinga, Muuka and Namazambwe)
3.	World Vision C-SAFE	April 2006	August 2006	To provide food aid to chronically ill, malnourished under-5 children, malnourished pregnant & lactating women and OVCs and food for assets to food insecure but able bodied.	Free food aid Food for assets	Food for assets projects (road maintenance, Conservation farming & weir dam construction in collaboration with Kaluli Development Foundation)	12,000 people (2,000 households)	Food aid: cereals & pulses	355 MT cereals 85.54 MT pulses (beans)	Covering Nangombe, Mweemba, Malima, Nkandabbwe, Mweenda, Muuka & Mwezya wards

4.	Red Cross Society	April 2006	May 2006	To ensure wide spread food security and attainment of sustainable food and livelihood security whilst mitigating the negative effects of HIV/AIDS pandemic in its target areas.	Free food aid	Livelihood support (small scale irrigation for gardening, crop production and food processing & utilization.	16,000 people (2,199 households)	Food aid: maize meal, beans, HEPS and cooking oil	317.615 MT maize meal 51.139 MT beans 16,000 litres cooking oil 88.132 MT HEPS	Targeting households of PLWHAs including clients of HBC, household keeping orphans and OVC. Covering Mwezya, Sinazongwe, Maamba, Mweemba, Muuka & Nkandabbwe wards
5.	Catholic Church/WFP	December, 2005	May 2006	To reduce the risk of HIV/AIDS persons to poor nutrition and low food availability.	Free food aid to ART clients	Home Based Care programmes	195 ART clients	HEPS, maize grain, pulses and cooking oil	87.75 MT maize grain 11.7 MT pulses 16.848 MT HEPS 2,925 Litres cooking oil	Ration per client: 75kg maize grain; 10kg pulses; 14.4kg HEPS; and 2.5 litres cooking oil Covering Maamba, Nkandabbwe, Sinazongwe, Mweemba, Nangombe, Mwezya and Malima wards
6.	Churches Council of Zambia	February, 2006	April, 2006	To mitigate food insecurity to drought affected households	Provision of free food aid	Conservation farming training Goat pass on the gift project School feeding programme (1 school)	400 households	Food aid: maize grain, beans and groundnuts	60 MT maize grain; 6 MT beans and 6 MT groundnuts.	Covering Mweemba ward. 400 households trained in conservation farming practices 40 households to be given 2 goats each

Source: DDMC, 2006

Reference

DDMC 2005 Food Situation and Availability: Brief Report Presented to World Food Programme Representatives Visiting Sinazongwe District on 17th December 2005.

DDMC 2006 Terminal report on the 2005/06 Relief food Programme, Sinazongwe District.

MACO Sinazongwe District 2005 Crop Assessment and Food Availability Survey Report.

Siamwiza Bennett 1998 A History of Famine in Zambia c. 1825-1949. PhD Thesis in University of Zambia.

RIHN Agricultural Household Survey, 2005/2006 Agricultural Season

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Background and Purposes

The Research Institute for Humanity and Nature (RIHN) Agricultural Household Survey (RAHS) of 2005/2006 agricultural season is conducted to supplement Post Harvest Survey (PHS) conducted annually by the Central Statistical Office of Zambia. The primary aim of this survey is to assess vulnerability and resilience of subsistent small holders to climatic variations. The data will be used to assess impacts of climatic shocks on farm production, to identify vulnerable households, to identify factors influencing resiliency to systemic shocks and to simulate on various possible policy instruments that can enhance resilience of small holders.

The RAHS creates new opportunities that the existing PHS alone cannot provide. By design, this survey is to join with the PHS 2003/2004 and 2004/2005 to create a panel data of three years. Usually, PHS is a repeated cross-section. The accidental panel that happened in the PHS 2003/2004 and 2004/2005 was a result of unexpected budget shortfall at CSO. To take advantage of this otherwise too short panel data, the RAHS was launched to create a longer panel. Such panel data will enable us to study dynamics of household and production and overcome some analytical limitations that are common in repeated cross-section analysis. In addition, RAHS supplements the PHS with wider coverage which includes farm and off-farm income, resource endowment, poverty assessment, health, consumption and coping behaviors. This wider coverage will help us better assess the vulnerability and resilience of the small holders to climatic variations.

Sample Design

Sampling method of RAHS is based on PHS's stratified random sample. The population is first stratified into standard enumeration area (SEA) with probability of being selected being proportional to its size in the first step. In the next step, a number of small farming households living in selected SEA, which cultivates on more than 0 hectare to no more than 15 hectare of land, will be selected. The sampling frame of SEAs is based on Census of Population and Housing in 2000 and 410 SEAs were selected for PHS.

Scope and Coverage

In this study, the project covers 59 SEAs previously selected in 2004/2005 in Eastern and Southern Provinces. Given project's budget constraint, 59 chosen SEAs were optimal. Both Provinces were chosen to control for level of poverty that influences household vulnerability and resilience. Their poverty levels are of intermediate severity relative to the rest of the country with about the same poverty headcounts at 70 percent in 2004 (Simler, 2007[1]). On the other hand, their differences in geographical conditions, ethnicity, crop patterns and resource endowments provide needed variations for subsequent data analyses. The distributions of SEAs are shown in the table below:

Table 1: Numbers of Selected SEAs by District

DISTRICT	NUMBER OF SEA
Eastern Province	
Katete	11
Mambwe	3
Nyimba	4
Petauke	14
Subtotal	32
Southern Province	
Choma	8
Gwembe	2
Kalomo	7
Monze	7
Sinazongwe	3
Subtotal	27

The selection of the SEAs is not designed to represent provincial situations. This is not necessary a drawback because the focus of this survey is to examine behavior at household level and not to obtain provincial production estimates as it is done in the PHS.

A total of 20 households that were previously interviewed in the PHS 2003/2004 and 2004/2005 are selected from each SEA. The expected sample size is 1,180 households. However, CSO attempted to conduct an interview on 1,156 households of which 1,011 households completed the interview. This constitutes an attrition rate of 12.5 percent. Important reasons for failure to get complete response are (i) moving out of SEA, (ii) non contact, and (iii) households dissolved. The distributions of response status are shown in table 2 below:

[1] Simler, K., (2007), Micro-Level Estimates of Poverty in Zambia, Lusaka: Central Statistical Office.

Table 2: Response Status of Selected Households

RESPONSE STATUS	NUMBER OF HOUSEHOLDS	PERCENT
Complete	1,011	87.46
Refusal	2	0.17
Moved out of SEA	56	4.84
Household dissolved	33	2.85
Non contact	54	4.67
Total	1,156	100.00

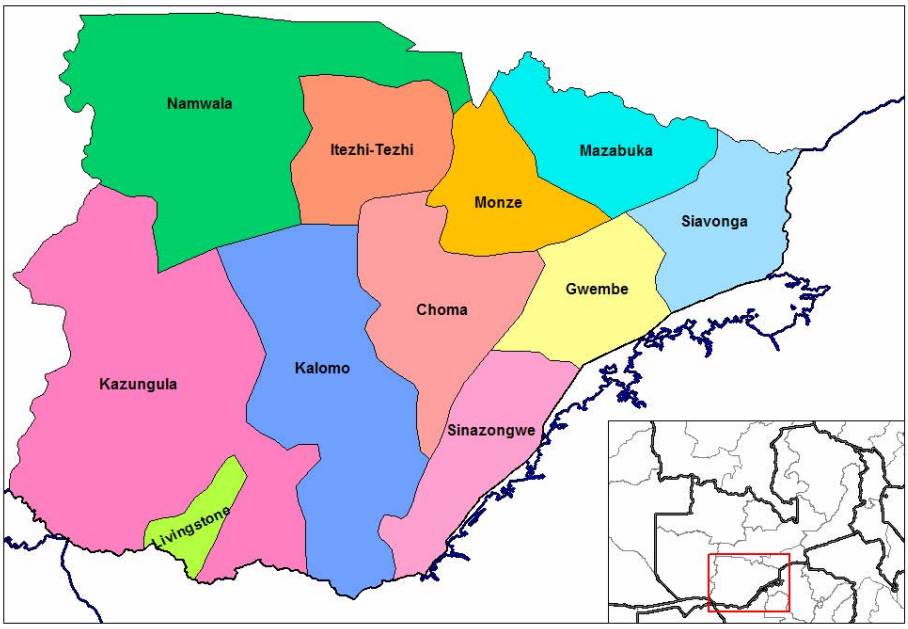

Figure 1: **District Map of Southern Province, Zambia**

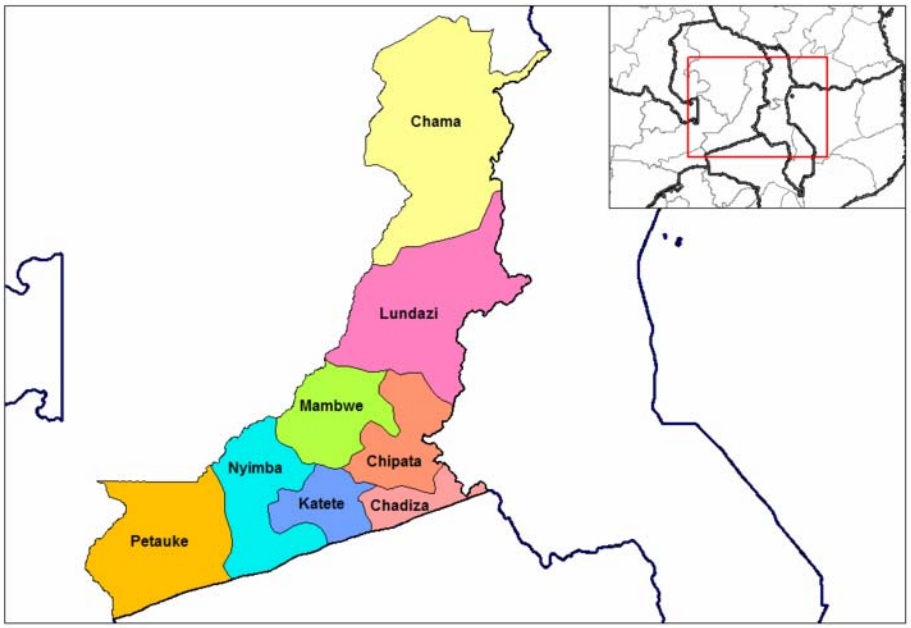

Figure 2: **District Map of Eastern Province, Zambia**

Survey Instrument and Reference Period

RAHS Survey instrument is adapted from two instruments one of which is the Food Security Research Project/Michigan State Unitversity's Supplemental Survey and the second of which is CSO's Living Condition Monitoring Survey. The RAHS covers the following aspects, i.e.

- production, sale and stock of crops, vegetables, fruit trees,
- input use,
- income and remittance,
- assets,
- consumption,
- poverty status,
- household coping strategies.

The instrument is 40-pages long. The survey focuses mostly on 2005/2006 agricultural season.

Survey Preparation

After developing questionnaires, two joint seminar sessions were organized during the pre-survey stage in March 2007. The first seminar was a meeting between RIHN's researchers and CSO's coordinator, analysts, data manager and statisticians from Lusaka, Southern and Eastern Province offices. The purposes are to clarify objectives, concepts,

structure of questionnaires and to solicit feedback to refine questionnaires. This process took place at CSO's main office in Lusaka and it took one week to complete the seminar. The second seminar was held at provincial level. Participants are enumerators, field supervisors and provincial statisticians. The purposes of this seminar were not only to clarify objectives, concepts and questionnaire structure but also to provide practical skills needed to conduct successful survey. The training took ten days. Immediately after completing the training, enumerators and field supervisors were sent out for field tests. Objectives of pilot testing are two folds. One is to ensure that the questionnaires are capable of collecting desired information and the other is to familiarize enumerators with field interview. The survey was launched in both Provinces simultaneously on March 28, 2007 and completed on April 30, 2007.

Supervisors and Enumerators

Quality supervisors and enumerators are keys to a successful survey. Two supervisors and ten enumerators were deployed for each Province. While supervisors are CSO's official, enumerators are temporary employees that were recruited on a job-based basis. A minimum high school graduation and ability to speak local language are prerequisites for enumerators. The majority of enumerators are experienced field interviewers. Poor job market in Zambia was the main reason for CSO to be able to consistently employ the same group of enumerators. Initially, it took enumerators more than two hours to complete an interview. Growing more accustom to the flow of questionnaires, however, enumerators reportedly took about 90 minutes to complete the household interview. The completed questionnaires were then checked by the supervisors.

Data Entry and Submission

After completing the survey, questionnaires were brought to CSO main office in Lusaka for data entry. The first batch of data files submitted to the institute was in June 2007 and the last batch of files received was on November 11, 2007. A total of 61 data files have been received. The delay of data submission was mainly a result of failure of a supervisor to collect GPS coordinates of 30 sample households in Southern Province. The CSO coordinator had sent out an employee to recollect GPS information. Furthermore, responses to some questions were not input. Upon several repeated verifications, a numbers of observations with incorrect identifiers and identifier shifting were discovered and corrected. At the time of this writing, all known issues have been addressed and corrected. However, an extreme value

issue that is common in field survey remains. Response error, coding error and data entry error are the likely causes of this extreme and implausible value problem.

Data Quality Assessment

High quality data are essential for any research. In reality, no survey data are perfect despite careful planning and execution. To gain some idea about the quality of RAHS data set, we set out to visit some sampled households in September 2007 in Eastern and Southern Province. Chief purposes of this visit were to gain first hand knowledge of farmers' livelihoods, living condition, and environment. Additionally, the research team wished to cross verify information recorded in the questionnaires.

It is found that some farmers have a tendency to under report income generating activities and production. Those under reporting farmers may have been motivated by a faulty speculation that such behavior would likely qualify them for financial or non-financial aid the survey would bring. Nevertheless, this phenomenon is not uncommon. In more developed countries, some respondents tend to under report cash income for fear of tax consequences.

In a village in Southern Province, an enumerator was found to make serious omissions in recording off-farm business activities of a household. That particular household happened to extensively involve in several businesses at the same time. There was no indication that members of that household attempted to conceal information. They even openly and proudly shared information about their livelihood activities and an amount of income they make. Though disappointing, it is difficult to generalize about prevalence of such interview omissions from a very small number of household revisits. What is more important is that what were recorded was recorded accurately among cooperative households. For some reasons, some household intentionally give misleading information to the enumerators. Fortunately, that inaccuracy found was not on a critical part of the survey.

No similar interviewer's omissions were found in Eastern Province. Interestingly, we discovered that households living near the border are likely to conceal their cash generating activities because of their involvement with cross border trading some of which was socially acceptable but not legally.

Incidences of enumerator or supervisor errors were relatively higher in the Southern than in Eastern Province. However, there are some indications that response errors are likely to be higher in the Eastern Province especially areas near borders. No evidence of any enumerators, beside the case of interview omission, intentionally recorded inaccurate information. The response and enumerator errors are not uncommon in survey data especially

one that is conducted in developing countries. The key issue is not whether or not those errors exist but rather at what degree. It is difficult to give objective evaluation of the quality of RAHS data set based on limited information. Detecting data abnormalies will provide more accurate assessment. Perhaps, it suffices to argue at this early stage that RAHS data are of equal or greater quality than any other standard surveys CSO has ever conducted. The logic of this argument is based on the panel nature of this survey. Unlike cross-section survey, data abnormalies can be detected with greater ease in panel data and, therefore, an incentive to intentionally record inaccurate data is lessened among those whose opportunity costs are greater than short-run benefits gained from under-work.

Future Improvements

A drawback of this survey is probably its untimely execution of the survey. Ideally, the survey should have been conducted immediately after the end of the 2005/2006 agricultural season to reduce recall errors. However, this delay happened not by choice but by necessity. The project commenced in fiscal year 2006/2007. By the time all preparations were in place, it was not possible to immediately conduct the survey during planting season in Zambia because the majority of the sample areas were not accessible during rainy season. Immediately after the arrival of the next dry season, the survey was launched. Fortunately, this delay issue is not likely to reoccur in the next follow up survey.

The next follow up survey should focus on quality assurance. Survey instrument needs to be streamlined. Some questionnaires need to be sharpened to better collect the desired information. Recording and interviewing skills of enumerators can be improved by learning from imperfections in this survey. Third-party supervision can intensify CSO's supervising efforts and improve provincial coordination. Data entry needs to be done in a timely manner. It is obvious that there were production congestion at CSO. Third party data entry and checking is an attractive option to reduce errors from data entry and to avoid congestion at CSO. Costs of using third party can be offset, at least partly if not all, by reduced survey costs paying to CSO.

Summary

The primary purpose of the RIHN Agricultural Household Survey (RAHS) of 2005/2006 is to assess vulnerability and resilience of subsistent farming households to climatic variation. The survey covers 59 standard enumeration areas (SEAs) in Eastern and Southern Province for a net total of 1,015 households. What is so special about this cross-section survey is that it becomes a panel data of three years when combined with the Central Statistical Office's Post Harvest Survey (PHS) of 2003/2004 and 2004/2005 agricultural season. Furthermore, the survey covers wider area than what the PHS usually covers. Besides the production, sale and stock of crops, vegetable and fruit trees and input use, the RAHS interviewed farmers on in- and off-farm income and remittance, asset holdings, food consumption, poverty status, risks and coping behaviors. The survey was conducted by CSO.

From the research team's sampled household revisits, it has been observed that farmers have a tendency to under report production and income generating activities. This under reporting tendency becomes more pronounced in households locating near borders. Furthermore, our random interviewed confirmed that enumerators did record information accurately. However, an omission of a key section of questionnaires in one household was discovered and corrected. A weakness of this survey is the likelihood of recall errors since the survey was conducted one year after the target study year. Overall, it is believed that the RAHS is of satisfactory survey quality because the incentive for enumerators to perform duty honestly was heightened by the relative ease of detecting fraud in panel survey. Despite the data quality satisfaction, there still are ample rooms for improvement.

Research Organization for Trans-disciplinary Research: The Experiences from RIHN Watershed Projects

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1. Introduction

The importance for consilience among different disciplines for solving global environmental issues has long been discussed among researchers and decision makers. As the problem becomes more complex in the real world, the society calls for trans-disciplinary approach for analyzing and solving environmental problems. Watershed is a geographical boundary of ecosystem that supports social and economic activities in the regional scale. The problem of watershed is considered to have multi-faceted aspects such as spatial and temporal aspects of material flow and balance, present and future climate conditions, resource use, hierarchical structure of social and cultural organizations and ownership. Thus sustainability of watershed requires "synthesis of knowledge from different specialized fields of human endeavor" (Wilson, 1998).

This chapter tries to review some trans-disciplinary research projects for watershed management and to consider effective research organization for achieving their goals. Particular focus is placed on how the project is integrating scientific knowledge/findings into policy formulations or providing recommendations for watershed resource management.

The organization of the chapter is as follows. First we try to identify the possibility of consilience in trans-disciplinary research. Stages of trans-disciplinary project and types of integration are explored. Second section briefly explains history, mission and organization of the Research Institute for Humanity and Nature. The third section describes experiences from three RIHN Watershed projects. The fourth section considers the evolution of research organization for trans-disciplinary research. The next section shows possible tools for integration. The last section concludes this chapter with some implications for resource management.

2. Consilience and Trans-disciplinary Research

In a path-breaking book, *Consilience: The Unity of Knowledge*, a biologist Edward O. Wilson mentioned that it is possible to unite the sciences with the humanities, and to synthesize knowledge from different disciplines. William Whelwell, in his 1840 book *The Philosophy of the Inductive Sciences*, first introduced the *consilience* and it meant:

> "literally a "jumping together" of knowledge by the linking of facts and fact-based theory across disciplines to create a common groundwork for explanation."
> (Wilson, 1998)

According to Wilson, the "new synthesis" of knowledge among natural and social sciences, as an example of consilience, is the unification of Darwin's theory of evolution with new information of genetics. The evolution theory was empirically tested by the new knowledge of genetics as the advancement of science. In case of environmental issues, Wilson asserts that political decision makers can not solve most of the problems "without integrating knowledge from the natural sciences with that of the social sciences and humanities." There is a need to link together knowledge from environmental policy, ethics, biology and social science since the most real world problems arises in the intersection of above domains (Wilson, 1998).

Then how is it possible to realize consilience? The rest of the section describes the types of project-type research and directions that is to realize consilience. Three stages of area studies are described in Tachimoto (2003, 2004). Those are multidisciplinary, comprehensive and integrated area studies. Although Tachimoto used these criteria for describing stages of area studies, we try to use them for stages of integrated project-type research for an analogy. The first stage is multidisciplinary project-type research. In this stage, members from different disciplines work together in the same project but they simply consider project as an arena for their own individual study. However, members are like vegetables in the salad bowl and there is almost no influence among each other for the outcome of the research. This may be true for the initial stage of so-called trans-disciplinary project. The second stage is comprehensive project-type research. In this stage, the project focuses more on comprehensive outputs and each members are somewhat influenced by other members in the project. The third stage is integrated project-type research that creates new arena for trans-disciplinary research. Ideally in this stage, a project serves as a melting pot for integrated study across disciplines with a wholistic approach to tackle issues and to realize consilience.

In addition, there are three typical directions of integrated research. One direction is to integrate through common concepts and missions for environmental issues to share among researchers from various disciplines. Thematic concepts such as *sustainability* and *resilience* may be examples for this venue. Another direction is to integrate through a method of analysis. An effort to integrate various field of science with a unified method or a model may be one example. The last direction is to integrate through studying the same geographical area. The area study that has developed particularly after the Second World War has this typical integration method.

3. **RIHN as a ground for Trans-disciplinary Research**

i) History

In 1995, the Japan Science Council proposed, "it is necessary to examine the founding of a central research organization that will promote integrated cooperative research toward the solution of global environmental problems." The Preparation Committee of the Institute proposed in March 2000 the foundation of the "Research Institute for the Global Environmental Sciences" to be established for promoting integrated research projects, by

amalgamating various broad disciplines from humanity and social sciences to natural sciences and build networks among university researchers within and outside of the country. The Research Institute for Humanity and Nature (RIHN) was founded in 2001 as one of the inter-university research institutes of the Ministry of Education, Culture, Sports, Science and Technology, the Government of Japan. In 2004, the Inter-University Research Institute Corporation, National Institute for the Humanities (NIHU) was established, based on the National University Cooperation Law. RIHN became one of the five member institutes of the NIHU. Other members are the National Museum of Japanese History, the National Institute of Japanese Literature, the International Research Center for Japanese Studies, and the National Museum of Ethnology (RIHN, 2007).

ii) Mission

Environmental issues, such as global warming, loss of biodiversity, and depletion of water resources are said to be the consequences of human-nature interactions and these consequences are now manifesting themselves in various parts of the world. It is fundamentally a problem of human lifestyle, or "human culture" in the broadest sense of the word (RIHN, 2007). It is an important mission for RIHN to achieve consilience in the area of global environmental problems. The true nature of global environmental problems becomes apparent through consilience, presenting a new paradigm to view problems. It will then become possible to draw up a plan for building a futurable society. In summay, RIHN's mission is to construct an integral wisdom as consilience and to solve global environmental issues, which it sees as deeply rooted in human culture (RIHN, 2007).

iii) Organization

In order to achieve RIHN's mission, RIHN carries out trans-disciplinary and integrated project-based research. The RIHN was originally designed to have a capacity of accommodating fifteen trans-disciplinary research projects. At the time of establishment in 2001, five RIHN projects were inaugurated under five research axes and approaches. Those were:

Axis 1: Environmental Change Impact Assessment;
Axis 2: Human Activity Impact Assessment;
Axis 3: Spatial Scale;
Axis 4: History and Time Scale;
Axis 5: Conceptual Framework for Global Environmental Issues.

Although the five research axes aimed at directing programs in the group, the trans-disciplinary interactions among projects in each axis were not very effectively organized. The trans-disciplinary integration was largely left with each project members although there were a great deal of interactions among researchers. As of 2007, five programs/domains were organized at RIHN to lead trans-disciplinary interactions and generating consilience among

domains. Five research programs/domains include circulation, diversity, resources, environmental history of civilizations, and global ecosophy.

Circulation Domain: Dealing with various kinds of problems as to the circulation of substances such as water, oxygen, carbon, and nitrogen in the human sphere and their imbalance and inappropriate uses.

Diversity Domain: Dealing with global environmental problems derived from the loss and degradation of genetic-specific and ecological biodiversity, as well as cultural diversity related to language, social structure, religion, and cosmology.

Resources Domain: Dealing with global environmental problems associated with food and energy resources and with the relevant economic activities (agriculture, forestry, fishery, and animal husbandry).

Environmental History of Civilizations Domain: Dealing with historical consequences of human-nature interactions, particularly of civilization as global environmental history.

Global Ecosophy Domain: Dealing with environmental issues in a particular regions/areas and to seek new approaches and methodologies to study global environmental problems.

RIHN project members are invited to participate more than one program meetings to seek common ground for trans-disciplinary research. Although research domains are purposed to represent integral perspectives of global environmental problems, trans-disciplinary organization and research has mostly been practiced and realized in each research projects. Therefore, the following session describes outlines and research focuses of three watershed projects at RIHN.

4. **Experiences from RIHN Watershed projects**

The initial five RIHN projects were studying on water issues, i.e., Seyhan River Basin, Oasis Region in Inner Mongolia, the Lake Biwa-Yodo River Watershed, and Global Virtual Water. Here, we show experiences from three watershed projects. First two are the completed projects. One is "Impact of Climate Changes on Agricultural Production System in the Arid Areas (ICCAP) (2002-2006)"; the second project is "Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed (2002-2006)." The third project is "Human Impacts on Urban Subsurface Environments (2006-2010)" that is to be completed in 2010.

4-1. Impact of Climate Changes on Agricultural Production System in the Arid Areas (ICCAP) (2002-2006)

a. Outline

ICCAP project was one of five research projects that started as the first phase of research

activities at RIHN in 2002. Their study site was the Seyhan River Basin that is located in the central south of Turkey. The Seyhan river extends to Adana City and flows into Mediterranean Sea. The total watershed area of Seyhan River Basin is 21,734 km^2 and the land cover class in upper and middle basin are dominated by rain-fed wheat and barley (22.2%), pasture (31.8%) and forest (19.4%). Along the downstream of the Seyhan River, the Lower Seyhan Irrigation Project (LSIP) in Adana was initiated by the Turkish government as one of the most important irrigation projects located in southern Turkey. The Government constructed the Seyhan Dam in 1956 for the purposes of irrigation, power generation and flood protection. The reservoir can store 1.2 billion cubic meters that supply irrigation water to LSIP. There is a concern among local authorities as well as farmers that how the future climate changes will affect the local agricultural production. The project was to answer this question by focusing on local impacts of climate changes in 2070's.

b. Objectives

The objective of the ICCAP was first to assess the impacts of climate changes during the 2070s and possible adaptations for it on agricultural production system in Seyhan River Basin. For this purpose, the main tasks were development of the methodology or model for the assessment, including the improvement of Regional Climate Model (RCM), for generating future regional climate scenarios. The second objective was to assess the vulnerability of agricultural production systems from natural changes and to suggest measures for enhancing sustainability of agriculture, through integrated impact and adaptive assessment of climate changes (ICCAP, 2007).

c. Research Organization

The project leader of ICCAP was Dr. Tsugihiro Watanabe, an irrigation engineer. The group consisted of more than one hundred researchers mainly from Japan and Turkey. The major collaborating institution was the Scientific and Technological Research Council of Turkey (TÜBITAK) and Cukurova University in Adana. Figure 1 indicates the research organization of ICCAP. The project researchers are grouped into six sub-groups based on conventional disciplines, climate, hydrology and water resources, irrigation and drainage, crop production, vegetation and socio-economics (Figure 1). The climate group provided the regional climate conditions during the 2070's using the RCM. Other groups assessed the impacts of climate changes in various aspects such as river flow, crop growth, vegetation changes, irrigation water and agricultural production of farm households.

d. Integration

The member of each sub-group was quite stable from the start to the end of the project although there were some integral transformation at the later stage. At the same time the RIHN researchers including post-doctoral fellows provided integral drives across disciplines

of six sub-groups. The integration activity and trans-disciplinary communication was most realized in the process of scenario formation for climate change (Figure 2). For making climate change scenarios, many researchers participated and discussed the possibilities in the future (Nagano et al., 2007). One of the integration efforts was made through various modeling exercises. The RCM developed by ICCAP utilizes the output from Global Circulation Model (GCM) and provides future climate conditions such as precipitation, temperature, radiation, wind speed and humidity. One of the integrated models of ICCAP is SiBUC (Simple Biosphere including Urban Canopy) land surface model that utilizes climate information from RCM for calculating river water flow. Also the output of SiBUC, water availability for LSIP, was used for analyzing cropping patterns that farmers may choose under the water constraints given by the scenarios (Figure 3). The ICCAP provided final output to the local authority General Directorate of State Hydraulic Works and the members of water users associations in LSIP for discussing and recommending strategies against possible future climate changes.

4-2. Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed (2002-2006)

a. Outline

The Lake Biwa-Yodo River Project was also the one of the first phase projects of RIHN. The Lake Biwa-Yodo River watershed is one of the most intensively human-dominated watersheds in Japan. Since the water quality of this area began to deteriorate in the 1970's, Shiga Prefecture has worked on reducing the human load inflow by establishing laws and by promoting the development of sewage plants. Currently, the control of non-point sources, including agricultural drainage, has become an urgent issue, including turbid water flowing out from the paddy fields through medium and small rivers and finally into Lake Biwa (Yachi, 2006).

In General, a watershed has a "nested" structure that encompasses the human the human activities that develop within it (Figure 4). The project particularly focused on ways of viewing the problems occurring in the watershed at each level, because differing views can cause conflicts of interest between levels and thus obstruct watershed management. They consider the reason why watershed management is not working well is that active communication aimed at balancing competing interests is blocked, leaving a variety of stakeholders dispersed over the different levels. Thus the Lake Biwa watershed was chosen as an example of this kind of nested structure defined as a hierarchy consisting of three spatial levels: macroscale (the entire watershed), mesoscale (the regional community), and microscale (the local community) (Yachi, 2006).

b. Objectives

The four objectives were designed to be achieved through interdisciplinary partnership and local execution in each hierarchy: (1) clarification of the entire problem; (2) development of environmental diagnostic indices for each hierarchy and research on a method to support adaptive management; (3) establishment of a methodology for the promotion of inter-hierarchical communication; and (4) for the Yodo River watershed, which constitutes the downriver reaches of Lake Biwa, the identification of important problems related to the water environmental problem, based on the research activities related to the Lake Biwa watershed. Based on these case studies, the project intended to provide appropriate recommendations for the watershed management of the Lake Biwa-Yodo River watershed and to contribute to the establishment of global *environmentology*, i.e., a new synthesis of global environmental studies.

c. Research Organization

The Lake Biwa-Yodo River watershed project was led by Dr. Shigeo Yachi, a theoretical ecologist. The total number of project members was forty-eight including eight RIHN researchers. Figure 5 shows the research groups of the Lake Biwa-Yodo River Project. The project consisted of four working groups (WGs), Material Cycling WG, Ecosystem WG, Social & Cultural WG, and Watershed Information System WG. The number of project member increased from 19 in 2002 to 48 in 2007. Along the project implementation, various working groups were organized during the project period to support the research activities (Tanaka, 2007a). The Integrated WG, seven core members and other members who like to participate, discussed detailed research plans by sharing the concept of "watershed management model". Also, other working groups not shown in Figure 5 are formed to meet their research needs. Those working groups included Extended Material Cycling WG, Social Psychology WG, Paddy Field WG, Environmental Economics WG, Yodo-River Downstream WG. The meetings of those working groups accelerated trans-disciplinary communication among researchers.

d. Integration

Practical methods of watershed diagnosis for hierarchical watershed management include two important aspects. One is the use of indices, models and geographic information systems (GIS) and the other is stakeholder communication. Those two aspects also represent naturally integrating methods for the Lake Biwa-Yodo River Project.

They found that small to medium sized rivers, in the farming area east of the Lake Biwa, are responsible for discharging acid and minerals, such as sulfuric acid, nitric acids, bicarbonates, calcium, and magnesium. These acids are produced by farming activities and have eluted minerals from the soil and caused changes in the water quality of the lake. They utilized GIS so that the scientific information, such as turbid water discharge and water quality (stable isotope compositions) is mapped onto GIS for visualization and

communication with stakeholders.

Another important aspect of integration is placed on stakeholder communication by performing interviews, conducting questionnaire-based surveys and holding various workshops/meetings with stakeholders. They interviewed residents from 35 communities in the region on water management and use, and integrated the data, along with detailed data on the region and on the Lake Biwa watershed, into the GIS database. Based on the results, workshops were held in three communities, at which the residents themselves discussed the locations of beautiful and comfortable waterside areas using maps. The workshops were and attempt to encourage residents to notice the actual regional waterside environment and form desired future visions.

The integrated efforts are delivered by project proposal on "hierarchical watershed management system" based on 1) adaptive management appropriate for each level, and 2) communication between levels. In Figure 4, hierarchical watershed management means that communities and stakeholders at each level undertake specific functions and perform diverse activities related to the watershed at their level. Actions in each unit involve drawing up a plan (P), monitoring the process (D and C), analyzing and assessing the results of monitoring (A), and making necessary revisions.

4-3. Human Impacts on Urban Subsurface Environments (2006-2010)

a. Outline

Securing water resources and preventing contamination of water caused by human activities in urban areas are global environmental issues in the 21st century. Heat island phoenomena caused by human activities is also a big environmental problem in addition to global environmental warming. These global environmental issues which are caused by urbanization, should be addressed strongly and prevented as population and density increases occur rapidly in urban areas.

Most global environmental studies have long been focused on the environmental issues above ground, such as air pollution, global warming, seawater pollution, and decreases in biodiversity. Subsurface environmental issues are also important for human life in the present and future, but have been largely ignored because of the invisibility of the phenomena and difficulty of evaluations.

Subsurface environmental problems such as subsidence due to excessive pumping and groundwater contamination have occurred repeatedly in Asian major cities with a time lag depending on the development stage of urbanization. Therefore, the project is to assess future scenarios if we can evaluate the relationships between subsurface environmental problems and the development stage of the city (RIHN, 2007).

b. Objectives

The project address the sustainable use of groundwater and subsurface environments to provide for better future development and human well-being. The primary goal of the project is to evaluate the relationships between the development stage of cities and various subsurface environmental problems, including extreme subsidence, groundwater contamination, and subsurface thermal anomalies. The project targeted the following four research topics: (1) relationship between the development stages of the cities and subsurface environmental problems which will be assessed by socio-economic analysis and reconstruction of urban areas using historical records; (2) serious problems in subsurface environments and changes in reliable water resources which will be studied after evaluations of groundwater flow systems and changes in groundwater storage using hydrogeochemical data and in-situ/satellite-GRACE (Gravity, Recovery and Climate Experiments) gravity data; (3) evaluation of accumulation of materials (contaminants) in subsurface and their transport from land to ocean including groundwater pathways using chemical analyses of subsurface water, sediments and tracers; and (4) subsurface thermal contamination due to the "heat island" effect in urban area by reconstruction of surface temperature history and urban meteorological analysis (RIHN, 2007; Taniguchi, 2007).

In order to pursue above objectives and research targets, Tokyo, Osaka, Bangkok, and Jakarta are targeted as main study cities, and Taipei, Manila and Seoul are selected as secondary study cities, depending on the four sub-themes. The project focuses on the urban subsurface environments and treats the problems on a basin scale, because subsurface water, heat, and material transports are interconnected on this scale. We will assess the relationships between subsurface environmental changes and human activities during the past 100 years.

c. Research Organization

The project leader of Urban Subsurface Environments is Dr. Makoto Taniguchi, hydrologist. The project has six research groups as shown in Figure 7. "Social economic group" and "urban geography group" is organized to study the first research topic, "water group" and "gravity group" for the second research topic. Material group and heat group is to study the third and fourth research topic respectively. Based on the field surveys in targeted cities and assessments of natural and social data in each city from six research groups, they are to built project database/platform on GIS for further analysis.

d. Integration

The project is still in the process of developing methods of integration. One of the integration methods of this project is to focus on historical changes of four research targets from 1900 to 2000 and to use GIS for mapping historical data. Then this database/platforms is to be utilized for visualization and analysis of urban subsurface environments in target cities. Preliminary models such as GRACE, groundwater flow, and DPSIR (Driving force, Pressure, State, Impact, Response) have been established in each sub theme for providing

scientific information on urban environments. In order to evaluate the origin and process of material loads to the subsurface, isotopes and chemical analyses of water samples with new tracers techniques using CFC, Kr are introduced. In addition to GIS, integrated models and indicators natural and social science information will be developed to provide recommendations for sustainable groundwater management and subsurface environment of cities.

5. Evolution of Research Organization for Trans-disciplinary Research

Different type of research organization has evolved in RIHN projects since the establishment. The project leader chooses a type of research organization for his/her project depending on the mission and the methodologies to approach important issues of the project. The most common research organization of project-type research can be categorized into three types; discipline, target and issue/theme oriented research organization. Although the mission of the each project is different, there are various reasons to adopt a particular type of research organization for a project. Research organization is particularly important to achieve the mission and goals of the project.

a. Discipline Oriented Research Organization (first phase)

Most of the initial RIHN projects had this type of research organization. In this research organization, the project is grouped into sub-groups based on conventional academic disciplines, such as climatology, hydrology, agronomy, socio-economics as you can find in university departments. The benefit of this research organization is that it is easy to form and communicate/work among members since the members of the sub-group is mostly from the same discipline, same academic society, and sometimes from the same department of the same university. However the problem of this research organization is that it is difficult to integrate with other group with different disciplines. The ICCAP was the typical example of project that formed this type of research organization.

b. Target Oriented Research Organization (second phase)

The another research organization, target oriented research organization, appeared as the second phase of RIHN projects. Not like discipline oriented research organization, this research organization has a particular target object of research. In this way, researchers from different discipline can possibly work together focusing on a target of research. For example, the Lake Biwa-Yodo River watershed project had a group targeted to “material cycling” and “esosystem” and “social and cultural issues”. The Urban Subsurface project has a research organization that target research on water, heat, contamination and a city. The advantage of this research organization is that it is easy to focus research topic but difficult to make a wholistic view.

c. Issue/Theme Oriented Research Organization (third phase)

The pursuit of more trans-disciplinarity made another type of research organization, i.e., issue/theme oriented research organization. Based on the experience that discipline oriented and target oriented research organizations are not enough for trans-disciplinarity, issue/theme oriented research organization aims at tackling particular working hypothesis/issues with a trans-disciplinary group from the beginning. Urban subsurface project is considered a combination of target oriented and issue oriented research organization since each sub-group has a particular target as well as issues to focus on. In this way, it will make easier to focus on issues for trans-disciplinary output from the earlier stage with relatively small number of researchers that required pursuing each goals. For establishing this type of research organization, trans-disciplinary leadership is essential.

Table 1 shows the characteristics of various research organizations. For facilitating easy communication among sub-group members, discipline oriented research organization has an advantage over other research groups. On the other hand, research focus is better made through target oriented research organization. Furthermore, trans-disciplinary integration becomes easier when we make issue/theme oriented research organization. For example, ICCAP started with discipline oriented research organization. Through the course of project implementation, the group members transformed more towards target and issue oriented research organization at the later stage of the project. The Lake Biwa-Yodo River project and the Urban Subsurface project are geared to target/issue oriented research organization compared to ICCAP. Nevertheless, the success or failure of the project output is not only depends on how the research groups are organized but also depends on the inter-disciplinary communication among project members to pursue particular goals.

6. **Tools for integration**

For integration of the project output, there may be many practical ways and tools to consider. Table 2 indicates examples of tools for integrating outputs from different disciplines. The x shows the relative focus of each tool within the project and they not comparable across projects. One way is to map spatial changes and try to overlay of various parameters and variables for comparison. Also, similarly we can map historical changes and try to trace various parameters and variables. This gives us an easy exposition and visualization of target indices across space and time. The above two methods are often realized by using GIS techniques. The third method is to show some indicators for new insight. The indicator can be both for quantity and quality, or totally new composite indicator for indicating things from different perspectives. Modeling also is one of important tools for integration. The forth method is so called “coupled models” which has a component of social and natural science at the same time in one model. In the field of ecological economics, there is a strong tradition of coupled models. Especially mathematical biologists/ecologists are the pioneers of explaining human behaviors using ecological modeling. This is the natural science approach to integrate

social science. Also, social science modeling can embrace information from natural science for integrated analysis. The fifth method is communication among researchers. Project can be better integrated through smooth communication among researchers from different disciplines. This is not always easy because each discipline has their own technical languages, definitions, models, a way of approaching issues, i.e., induction or deduction. The sixth method is communication among stakeholders. Through communicating stakeholders, the output of the project is getting more integrated for communicating with community and the society.

The above-mentioned methods are sometimes combined. For example, all three RIHN watershed projects utilized GIS methods for showing spatial and temporal changes for communication. For ICCAP project, GIS is particularly useful for visualizing the impacts of future climate changes on water resources and agricultural production system in the region. The results were shared with local water authorities and water users associations in addition to university researchers (Nagano et al., 2007). In the Lake Biwa-Yodo River project, trans-disciplinary communication was very intense through holding various integrated working group meetings and publishing working paper series for dissemination (Tanaka, 2007a, 2007b). Also they focused on communication among stakeholders for showing their research output using GIS database. For the Urban Subsurface project, their focus is more on generating various indicators by intensive field observations and historical overlay for a long period of time.

7. **Conclusion**

We tried to consider research organization for trans-disciplinary research projects. In early stage of trans-disciplinary project, interactions among researchers may be minimal. As the problems of the real world become more complex, a need of both researchers and decision makers for comprehensive and integrative research becomes high for providing solutions to the environmental problems.

The experiences from three watershed projects revealed that different research organization was formed by each project as a result of their efforts for pursuing goals of the project and to implement a variety of research agendas. Through a pursuit of consilience, research organization evolved at the same time so as to focus more on trans-disciplinary output and solutions for environmental problems. In order to synthesize knowledge from different specialized fields of science, tools they adopted varied across projects depending on their focus of the project including mapping spatial and temporal indicators using GIS and stakeholder communications. There seem no golden rules for trans-disciplinary research since the research organization is selected for their particular research goals and needs of the project. Especially visualizing scientific knowledge using GIS is useful for communication among researchers as well as stakeholders concerned. Recent developments in a unified models for natural science and social science, for example in a study field of social-ecological systems, may possibly provide a common ground for explanation for consilience.

Reference

ICCAP. 2007. *The Final Report of ICCAP-The Research Project on the Impact of Climate Changes on Agricultural Production System in Arid Areas (ICCAP).*

The Lake Biwa-Yodo River Project. 2007. *Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed, Final Report.* RIHN, Kyoto.

Nagano, T., Y. Fujihara, K. Tanaka, C. Umetsu, K. Hoshikawa, T. Kume, F. Kimura and T. Watanabe. 2007. "Generated Social Scenario and Basin Condition for the Final Integration." *The Final Report of ICCAP-The Research Project on the Impact of Climate Changes on Agricultural Production System in Arid Areas (ICCAP).* RIHN, 15-18.

RIHN. 2006. *RIHN Annual Report 2005*.

RIHN. 2007. *RIHN Annual Report 2006*.

Tachimoto, Narifumi. 2003. "Methodological Issues for the Area Studies in the 21st Century" *Kokusai Kenkyu* 19: 148-156. Chubu University. (in Japanese)

Tachimoto, Narifumi Maeda. 2004. "Global Area Studies and Fieldwork." Discussion Paper No. 129. Graduate School of International Development, Nagoya University, Nagoya.

Tanaka, Takuya. 2007a. "Collaboration among Researchers in the Lake Biwa-Yodo River Project." Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed, Final Report. RIHN, Kyoto. 581-587. (in Japanese)

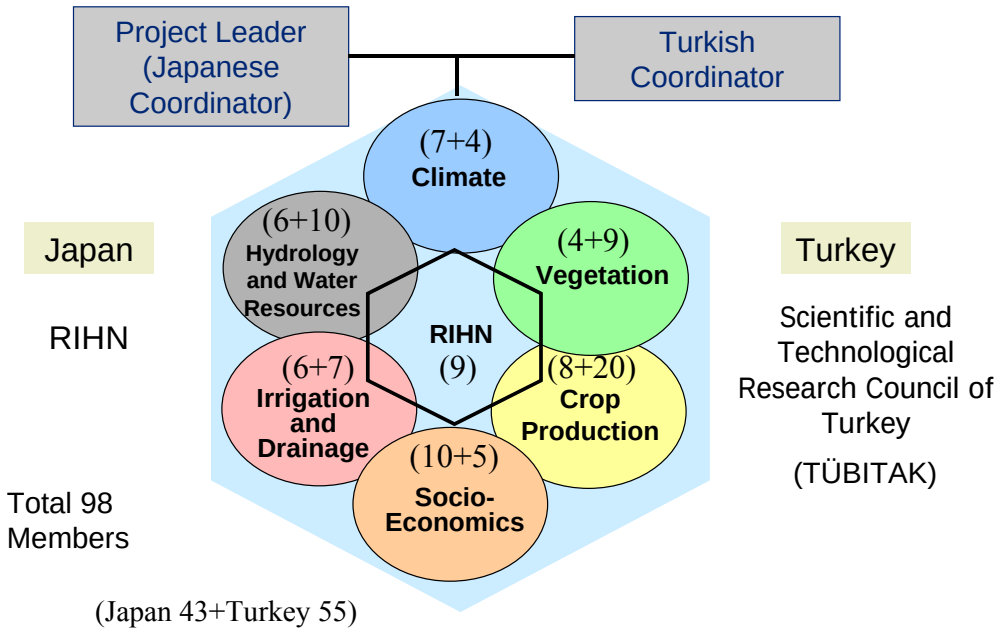
Tanaka, Takuya. 2007b. "Collaboration with the Local Community in the Project: The Case of the Lake Biwa-Yodo River Project and Inae Region." *Multi-Disciplinary Research for Understanding Interactions between Humans and Nature in the Lake Biwa-Yodo River Watershed, Final Report.* RIHN, Kyoto. 588-594. (in Japanese)

Taniguchi, Makoto. 2007. *Progress Report 2007: Human Impacts on Urban Subsurface Environments. No.4.* Research Institute for Humanity and Nature, Kyoto, Japan.

Umetsu, Chieko, K. Palanisami, Ziya Coşkun, Sevgi Donma, Takanori Nagano, Yoichi Fujihara, Kenji Tanaka. 2007. "Climate Change and Alternative Cropping Patterns in Lower Seyhan Irrigation Project: A Simulation Analysis with MRI-GCM and CCSR-GCM" *The Final Report of the Research Project on the Impact of Climate Change on Agricultural Production System in Arid Areas (ICCAP).* 2007. 227-239. RIHN, Kyoto Japan.

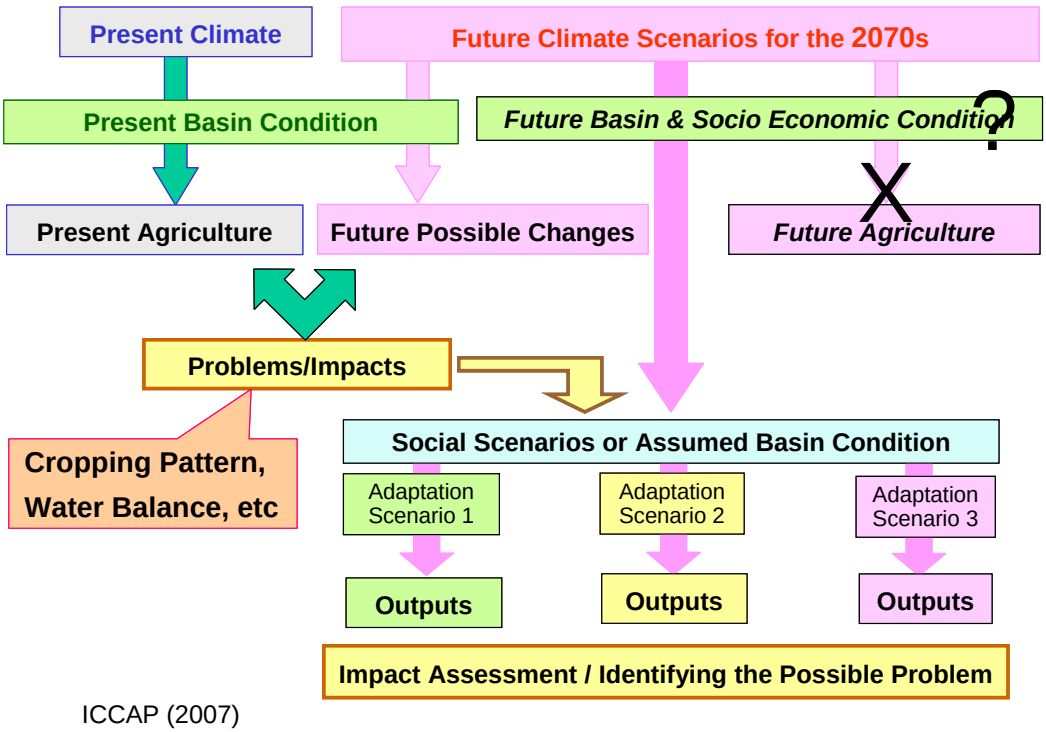
Wilson, Edward O. 1998. *Consilience: The Unity of Knowledge*. New York: Alfred A. Knopf, Inc.

Yachi, Shigeo. 2006. "A Hierarchy-based approach to the problem of agricultural water turbidity in the Lake Biwa Watershed." *RIHN 1st International Symposium Proceedings – Water and Better Human Life in the Future* -. November 6-8, 2006, Kyoto International Conference Hall, Kyoto. 81-87.



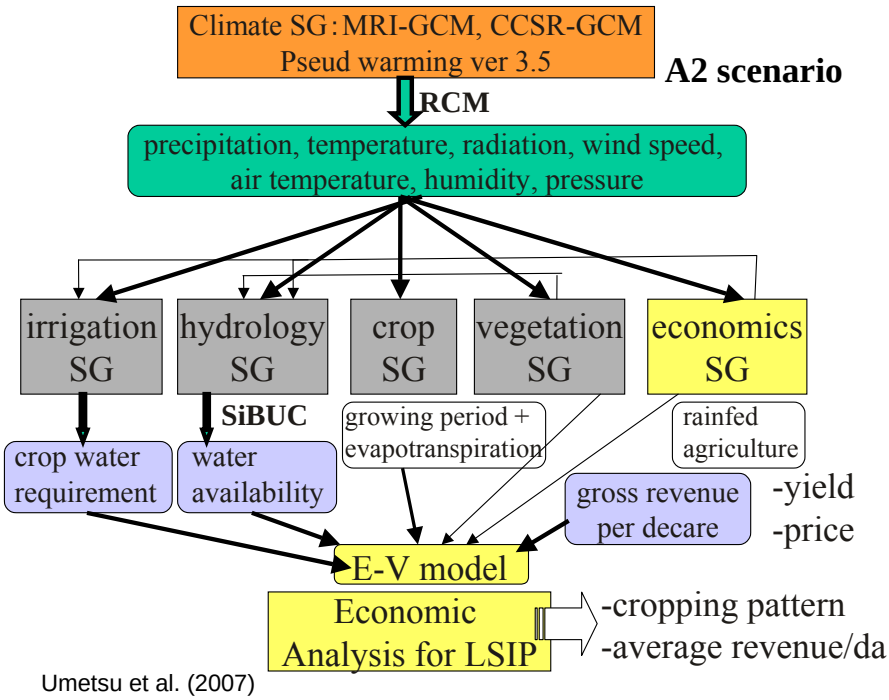
ICCAP (2007)

Figure 1. Six Research Groups of ICCAP



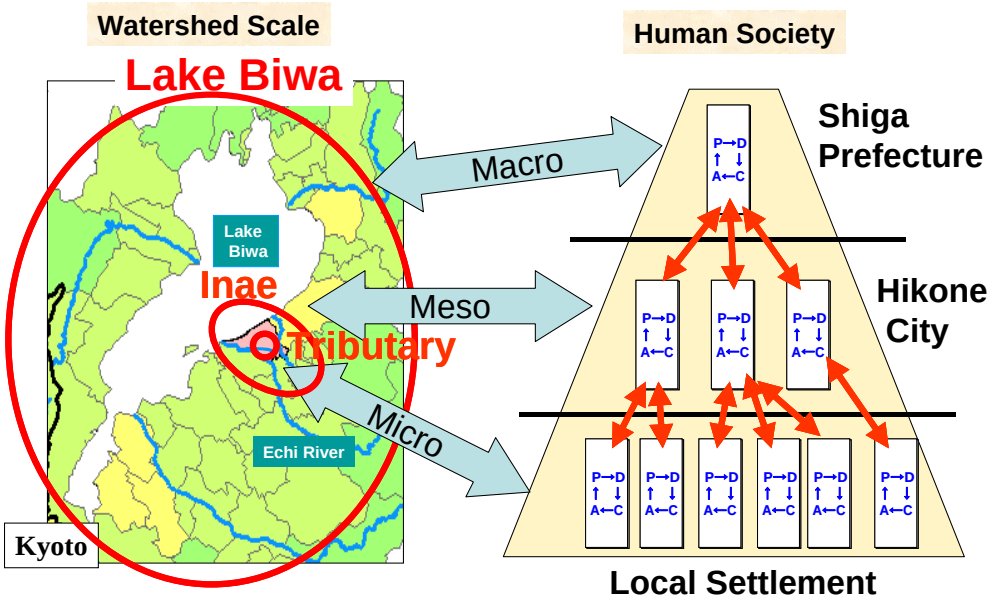
ICCAP (2007)

Figure 2. Impact Assessment Flow and Scenarios in ICCAP



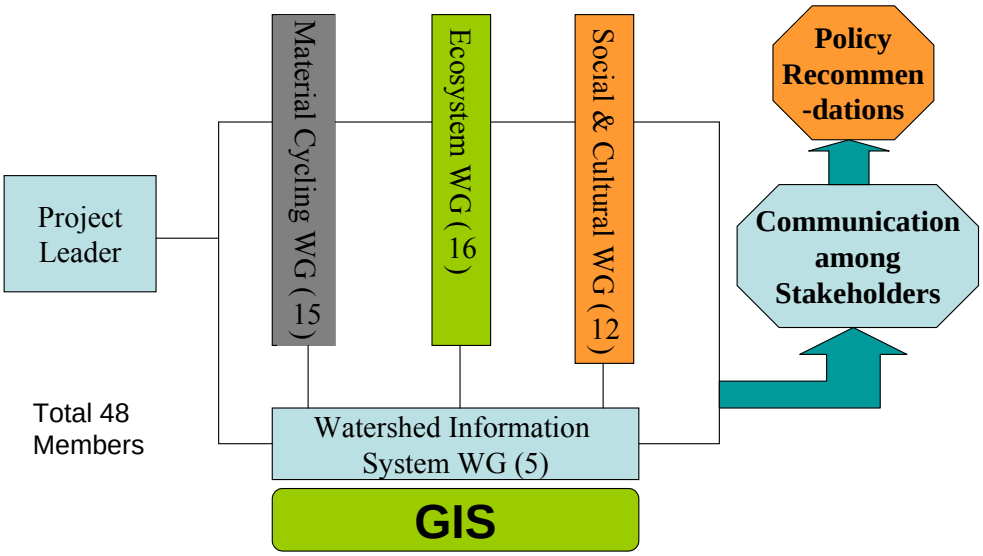
Umetsu et al. (2007)

Figure 3. Framework of Analysis for Integrating SG Outputs in ICCAP



Lake Biwa-Yodo River Project Final Report (2007)

Figure 4. Lake Biwa-Yodo River Project-Four Research Groups



RIHN Annual Report 2006 (2007)

Figure 5. Four Research Groups in Lake Biwa-Yodo River Project

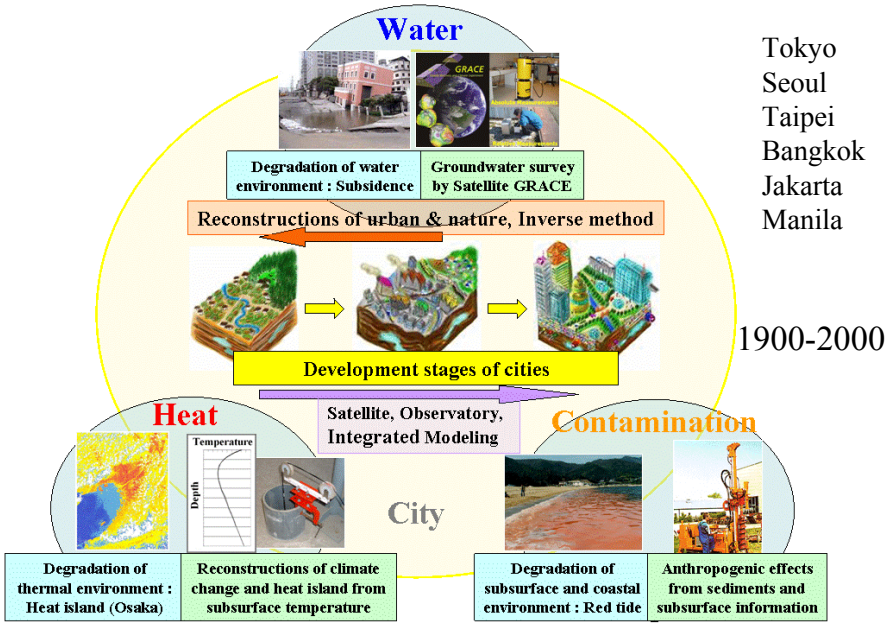


Figure 6. Human Activities on Urban Subsurface Environments

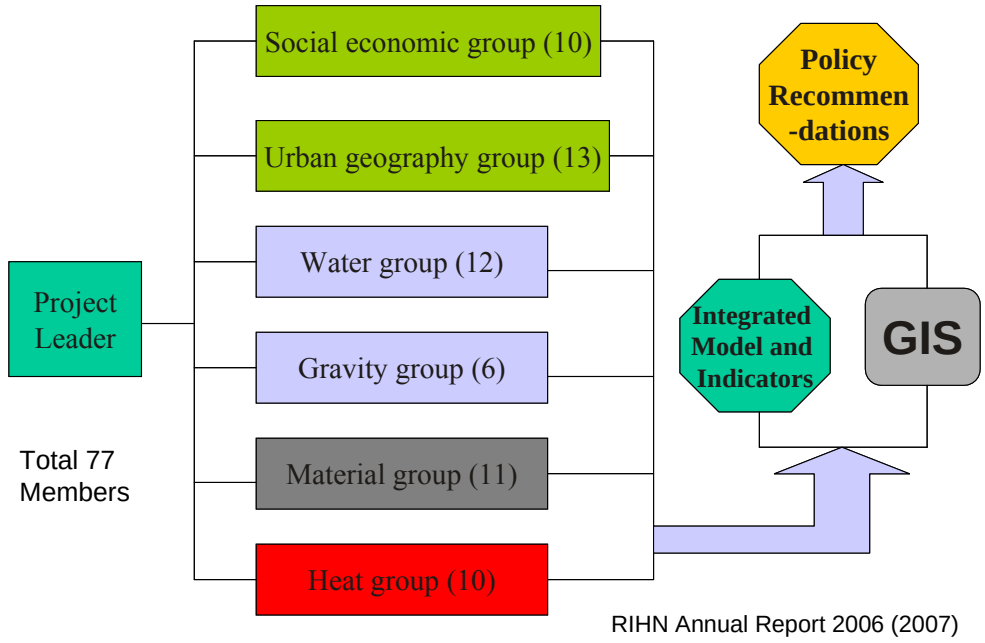


Figure 7. Six Research Groups of Urban Subsurface Environments Project

Table 1. Characteristics of Research Organizations

	Communication among Sub-group	Research Focus	Trans-disciplinary Integration	RIHN Projects		
				ICCAP	Lake Biwa-Yodo River	Urban Subsurface
Discipline Oriented RO	xxx	xx	x	xx		
Target Oriented RO	xx	xxx	xx	x	x	x
Issue/Theme Oriented RO	xx	xx	xxx		x	x

RO=Research Organization

Table 2. Tools for Integration

	Spatial changes	Historical changes	Indicators	Coupled models	Communication among researchers	Communication among stakeholders
ICCAP	xx	x	x	x	xx	xx
Lake Biwa-Yodo River	xx	xx	x	n.a.	xxx	xxx
Urban Subsurface	xx	xxx	xx	xx	xx	x

n.a.= not available

Resilience Project Second Workshop

Date： 2007 / May / 11th (Fri) 14:00-18:00 May / 12th (Sat) 8:30-17:00

Place： Curreac（Center in chamber of commerce and industry）

4597 Murakushi Hamamatsu Shizuoka 431-1207

Tel: 053-484-4155/Fax: 053-484-4150; URL: http://www.curreac.co.jp; E-mail: gd@curreac.co.jp

Program（presentation 10min、discussion 10min）

May 11th (Fri) Curreac Meeting room No.11

14:00-14:15 Registration （Travel document etc.）

14:15-14:30 Opening and the outline of Resilience Project
"Vulnerability and Resilience of Social-Ecological Systems"

（Chair UMETSU）

14:30-14:50 Seasonal and interannual variation of precipitation over Tamil Nadu, India
Akiyo YATAGAI （RIHN）,
V. Geethalakshmi （Tamilnadu Agricultural University）

14:50-15:10 Recovery of salinity damages on soil and ground water from the Tsunami, Nagapattinam district, Tamil Nadu, India
Takashi KUME （Arid Land Research Center, Tottori Univ.）

15:10-15:20 Break

（Chair SHINJO）

15:20-15:40 Spatial variability of soil properties in a Miombo woodland in eastern Zambia
Yoko NORO （Graduate School of Agriculture, Kyoto Univ.）

15:40-16:00 The diversity of farmers' livelihood systems and their assessment
Hidetoshi MIYAZAKI （RIHN）

16:00-16:20 Synthesis of soil management options for better targeting of technologies
Moses MWALE （ZARI）

（Chair LEKPRICHAKUL）

16:20-16:40 Determinants of Vulnerability of farm households: The case of Burkina Faso
Takeshi SAKURAI （Policy Research Institute, MAFF）

16:40-17:00 A plan of meteorological observation in Sinazongwe

Hiromitsu KANNO （National Agricultural Research Center for Tohoku Region）

（Chair SHIMADA）

17:00-17:20 Discussion about coping activities of food shortages in semiarid areas, Sahel
- Case study at a Tamasheq Village, North of Burkina Faso-
Yudai ISHIMOTO（Graduate School of Asian and African Area Studies, Kyoto Univ.）

17:20-17:40 The subsistence strategies under restriction of local power;
Angolan immigrants on Kalahari ands in western Zambia
Rumiko MURAO （Graduate School of Asian and African Area Studies, Kyoto Univ.）

18:00- Sub-group meeting by theme members

May 12th (Sat) Zuno Center Room 212

（Chair UMETSU）

8:30-9:30 Business meeting

9:30-10:30 The progress report and plan of each Theme

Theme I「Ecological resilience and human activities under variable environment」
Hitoshi SHINJO （Graduate School of Agriculture, Kyoto Univ.）

Theme II「How and when do farm households start perceiving a shock during the rainy season? A design of a detailed household survey in Zambia」
Takeshi SAKURAI （Policy Research Institute, MAFF）

Theme III「Political-Ecology of Vulnerability and Resilience: Historical and Institutional Perspective」
Shuhei SHIMADA （Graduate School of Asian and African Area Studies, Kyoto Univ.）

Theme IV「Integrated Analysis of Socio-Ecological Systems」
Mitsunori YOSHIMURA (RIHN)

10:30-10:40 Break

（Chair　SHIMADA）

10:40-11:00　Agricultural production and land use in Zambia

Kazuo HANZAWA　（College of Bioresource Sciences, Nihon University）

11:00-11:20　Economic and social factors affecting food security in Zambia

Shiro KODAMAYA　（Graduate School of Social Sciences, Hitotsubashi Univ.）

（Chair YOSHIMURA）

11:20-11:40　Global Monitoring on Environmental Change

Tazu SAEKI　(RIHN)

11:40-12:00　Preliminary Analysis for Vegetation and Land Use/Cover Monitoring in Multi-scale

Megumi YAMASHITA　（Survey College of Kinki）

12:00-13:00　Lunch

13:00-13:20　Political and social factors of food crisis: Preliminary research on early warning indicators for drought

Keiichiro MATSUMURA　（Graduate School of Human and Environmental Studies, Kyoto Univ）

13:20-13:40　Drought impact of the 2004/2005 agricultural season on crop production

Thamana LEKPRICHAKUL　(RIHN)

13:40-14:00　Large scale household survey and the possibility for integrating with spatial information

Chieko UMETSU　(RIHN)

14:00-14:20　Data Integration with Location Information and Spatial Application / Analysis

Mitsunori YOSHIMURA　(RIHN)

14:20-15:20　Discussion

15:20-15:30　Break

15:30-16:00　1. Research program for FY2007・Field Trip Schedule

2. Budget（UMETSU）

3. Acknowledgment in publication and presentation

4. A website and a logo (SAEKI・LEKPRICHAKUL)

16:00-17:00	Administrative information
	1. Business trips (Japan , overseas), cost reimbursement（IRIE and UMETSU）
	2. Field work and insurance of RIHN（UMETSU）
	3. Research Permission（UMETSU）
	4. Others （UMETSU and OTHERS）
17:00	Closing
17:30	To MAISAKA station by bus

RIHN's Research Project 1-3FR

Vulnerability and Resilience of Social-Ecological Systems

The First Lusaka Workshop
September 3, 2007

Date: Monday, September 3, 2007
Time: 9:00-17:00
Place: Conference Hall, Juls Guest House, Plot 5508 Lusiwasi Rd, Kalundu, Lusaka, Zambia
Tel: 260-1-292-979, 260-1-293-972

9:00 Registration
9:15 Welcome address
- Ms. Chieko Umetsu, Project Leader, RIHN
- Mr. Watson Mwale, Director of ZARI

9:25-10:35 Session 1 /Chair: Mr. Moses Mwale, ZARI

9:25 **Project Overview**
Vulnerability and Resilience of Social-Ecological Systems
Ms. Chieko Umetsu

9:45 **Special Lecture**
Vulnerability and Resilience of Social-Ecological Systems: Perspectives from Studies Underway in Zambia of Urban/Rural Food Marketing Systems
Professor Michael Weber, FSRP/MSU

10:35-10:40 Tea Break

10:40-11:40 Session 2/ Chair: Ms. Chieko Umetsu, RIHN

10:40 **Ecological Resilience and Human Activities under Variable Environment (Theme I)**
Mr. Hidetoshi Miyazaki & Ms. Yoko Noro

11:00 **Evaluation of Agroforestry Plants for Soil Fertility Restoration and Enhanced Sustainable Agricultural Productivity in Context of Resilience Research at Petauke, Eastern Zambia**
Ms. Sesele Sokotela

11:20 **Household and Community Response to Variable Environment (Theme II)**
How and When Do Farm Households Start Perceiving a Shock during the Rainy Season? A Design of a Detailed Household Survey in Zambia
Mr. Thamana Lekprichakul for Mr. Takeshi Sakurai

11:40-12:35 Session 3 /Chair: Mr. Thamana Lekprichakul, RIHN

11:40 **Political-Ecological Vulnerability and Resilience: Historical and Institutional Perspectives (Theme III)**
Ms. Chieko Umetsu for Mr. Shuhei Shimada

11:55 **The Socio-Economic Resilience in Rural Zambia in the Era of HIV/AIDS: Case Study of Nchelenge and Chipata**
Mr. Chileshe L. Mulenga

12:15 **Vulnerability and Resilience of Rural Society in Zambia: From the View Point of Land Tenure and Food Security**
Mr. Gear M. Kajoba

12:35-14:00 Lunch Meeting/Break

14:00-17:00 Session 4 /Chair: Mr. Mitsunori Yoshimura

14:00 **Integrated Analysis of Social-Ecological Resilience (Theme IV)**
Mr. Mitsunori Yoshimura

14:20 **Monitoring of Global Climatic Change and Its Impact on Africa**
Ms. Tazu Saeki

14:40 **Preliminary Analysis of Vegetation and Land Use Change during Drought: Multi-Scale Monitoring Approach**
Ms. Megumi Yamashita

15:00 **Political and Social Factors of Food Crisis: Preliminary Research on Early Warning Indicators for Drought**
Mr. Keiichiro Matsumura

15:20-15:35 Tea Break

15:35 **Drought Impact of the 2004/2005 Agricultural Season on Crop Productions**
Mr. Thamana Lekprichakul

15:55 **Extensive Household Survey and the Possibility for Integrating with Spatial Information**
Ms. Chieko Umetsu

16:10 **General Discussion/Comments/ Chair: Ms. Chieko Umetsu**

16:50 **Closing address**
Mr. Mitsunori Yoshimura, Theme IV's Leader, RIHN

Resilience Project Otaru Workshop

Date: March 8, 2008 8:00-18:30

Place: Classic Hall, Otaru Grand Hotel Classic

Shikinai 1-8-25 Otaru 047-1124; TEL.0134-25-9900 FAX.0134-25-9700

Workshop Program

8:00- 9:00	Theme Meeting
9:00-9:15	Summary of Project Activities in FY2007 and plan for the FY2008 Chieko UMETSU, RIHN
9:15-9:45	Labour Migrants in the City: From the Viewpoint of Ties between City and Village. Chihiro Ito, Graduate School of Asian and African Area Studies, Kyoto University
9:45-10:15	The Introduction of Labor Migration and Solution for its Impacts by Sahelian Agropastoralists－The Case Study of a Village in Northeastern Part of Burkina Faso－ Yudai Ishimoto, Graduate School of Asian and African Area Studies, Kyoto University
10:15-10:45	Rethink of African rural Development from Vulnerability Point of View Shuhei Shimada, Graduate School of Asian and African Area Studies, Kyoto University
10:45-11:30	Applied Research and Socio-ecological Resilience: Social Learning, People-driven Development and Climate Lawrence Flint, ENDA and RIHN
11:30-12:00	Progress of the Field Studies under Theme-1 "Ecological Resilience and Human Activities under Variable Environment' Ueru Tanaka, Graduate School of Global Environmental Studies, Kyoto University
12:00-13:00	Lunch
13:00-13:30	Farmers' Risk Management in Drought-Prone Area in Zambia Takeshi Sakurai, Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries
13:30-14:00	Longitudinal Monitoring Survey on the Growth and Nutritional Status of Children in Zambia Taro Yamauchi, Graduate School of Health Sciences, Hokkaido University
14:00-14:30	Annual Precipitation Variation in Southern Zambia and ENSO Signal Hiromitsu Kanno, Agricultural Research Center for Tohoku Region
14:30-15:00	Installation of Weather Stations in Southern Province, Zambia Tazu Saeki, RIHN
15:00-15:15	break

15:15-15:45	Satellite Image Analysis and Field Survey Plans for Vegetation and Landuse/Cover Monitoring Megu Yamashita, Survey College of Kinki Mitsunori Yoshimura, Remote Sensing Technology Center of Japan (RESTEC)
15:45-16:15	RIHN Agricultural Household Survey Report, 2005/2006 Lekprichakul Thamana, RIHN
16:15-16:45	Research Organization for Trans-disciplinary Research: The Experiences from RIHN Watershed Projects' Chieko Umetsu, RIHN
16:45-17:30	Discussion
17:30-18:30	Core Member Meeting

Abstract of Resilience Seminar in FY2007

The 17th Resilience Seminar

Date & time: Monday, April 23rd, 2007, 15:30-16:45
Place: RIHN Seminar Room 1&2
Title: Carrying capacity of land and environment of Africa
Speaker: Shigeru Araki, Professor, Graduate School of Asian and African Area Studies, Kyoto University

[Abstract] Distribution of people in the continent of Africa is extremely uneven, according to the local environment and indigenous agriculture and livelihood systems whose understandings play a key role in analyzing physical and social resilience against drought in southern Zambia. With this in mind, the expansion of arable land and population dynamics will be considered based on field observation in Tanzania, Zambia and Namibia.

The 18th Resilience Seminar

Date & time: Wednesday, June 20th, 2007, 15:30-16:45
Place: RIHN Seminar Room 3 & 4
Title: Synthesis of soil management options for better targeting of technologies and ecological resilience under variable environmental conditions
Speaker: Moses MWALE （Zambia Agricultural Research Institute）

[Abstract] Lack of access to food and its availability is of central concern in Africa and a fundamental challenge for human welfare and economic growth. Low agricultural production results in low incomes, poor nutrition, vulnerability to risks and lack of empowerment. The New Partnership for Africa's Development (NEPAD) targets an average annual increase of 6% in agricultural productivity to ensure food security and sustained national economies. Land degradation and soil fertility or nutrient depletion are considered as the major threats to food security and natural resource conservation in the semi arid tropics (SAT). What is needed is to break the cycle between poverty and land degradation in Africa by employing strategies that empower farmers economically and promoting sustainable agricultural intensification using efficient, effective and affordable agricultural technologies. Such affordable management systems should be accessible to the poor, small-scale producers and the approach should be holistic and dynamic in order to foster both technical and institutional change. This paper aims to increase the dissemination of our knowledge base on soils and its management in Zambia. This includes issues of soil conservation and conservation farming.

The main activities being to: inventories available technologies for alleviating land degradation and how to demonstrate and adapt the best-bets in farmers' circumstances using farmer participatory approaches; scale up best bet technologies for sustainable land management and marketing options through the use of appropriate tools, methods and strategies; and to study the resulting ecological resilience under variable environmental conditions.

The 19th Resilience Seminar

Date & time：Monday, July 30th, 2007, 15:30-16:45
Place：RIHN Lecture Hall
Title：Living with the Bible: The Growth of Independent Churches in Southern Africa
Speaker: Kenji Yoshida, National Museum of Ethnology

[Abstract] Since around 1990, there has been a rapid growth in the numbers of followers of so called independent churches in the southern Africa. Various activities of one of the independent churches in Zambia, namely Zion Spirit Church, will be discussed, and the origin of the church is to be scrutinized.

The 20th Resilience Seminar

Date & time: November 22nd, 2007, 15:00-16:30
Place: RIHN Seminar Room 3 & 4
Speaker: Prof. Gear Kajoba, University of Zambia
Title: Vulnerability and Resilience of Rural Society in Zambia: From the View Point of Land Tenure and Food Security

[Abstract]
The paper shows that pre-colonial ecologies of agricultural systems in some parts of rural Zambia were sustainable and resilient to prevailing environmental conditions, and were therefore able to ensure relative food security, under communal land tenure.

However, colonial policies of land alienation and labour migration impacted negatively on food production systems of some ethnic groups like the citemene system of the Bemba and the flood plain cultivation system of the Lozi, making them extremely vulnerable due to the absence of large numbers of males. Paradoxically, the Tonga people in Southern Zambia responded positively to the introduction of modern methods of cultivation, exhibiting resilience by adapting and adopting the cultivation of hybrid maize and the ox-drawn plough.

They also began to transform their land tenure system from being communal to become increasingly individualized.

At independence in 1964, the UNIP government intervened strongly in promoting rural development (1964-1990), by subsidising maize production and by implementing protectionist policies to maintain communal tenure. However, food security could not be guaranteed, and the policies led to over dependence of small-scale farmers on government and on maize at the expense of other food crops. The introduction of neo-liberal policies (from 1991 to 2001) by the MMD government coupled with adverse weather conditions, made food production systems rather vulnerable to both policy and environmental shocks. However, efforts are being made(from 2001- to date) to continue with land tenure empowerment policies to ensure secure land tenure for both men and women, and make targeted interventions with partial subsidies to rebuild the resilience of rural society, so as to promote national and household food security.

The 21st Resilience Seminar

Date & time: February 15th, 2007, 15:00-16:30
Place: RIHN Seminar Room 1 & 2

Speaker 1:
Mr.Tetsuya Nakamura, Graduate School of Asian and African Area Studies, Kyoto University
Title: The Livelihood of Tonga Peasant Farmer in Mountainous Area, Southern Zambia
[Abstract]
In 1950s, the huge artificial lake was developed by the construction of ‘Kariba dam’ at Zambezi River in Southern Zambia. As a result, over 50,000 ‘Tonga’ people were forced to migrate to the plane along the lake, where they had the pervasive problems of drought and land shortage. With this background, the study region, which is located on the Zambezi Escarpment covered by Miombo woodland between plateau and vally, is one of candidate sites of remigration. I try to disscuss about the livelihood at mountainous area, through the view of their social structure.

Speaker 2:
Miss Chihiro Ito, Graduate School of Asian and African Area Studies, Kyoto University
Title: Labour Migration as Livelihood Strategy: A Case Study in Southern Province, Zambia
[Abstract]

In African rural area, subsistent agriculture has long been the main mode of living. However, as the rural economy is highly integrated into monetary system, farmers find it harder to make their livings only out of agriculture, especially during the year of climatic and market variation. In response, they diversify their livelihoods in an attempt to mitigate and cope with those risks. Also in Zambia, non-agricultural activities have been the important income source for rural households; especially “labour migration” has played greater roles to sustain the rural economy.

Both international and domestic labour migrations were often seen in colonial period, to supply labour for mining in copper belt and plantations in Southern Africa. However, this kind of migration is different from the current migration patterns in rural area. Therefore, I consider Labour migration as livelihood strategy for peasants and my study aims at what kind of impact does it have on rural society and economy.

In this presentation, I will introduce about the characteristic of labour migration in my research area and discuss about the role of labour migration in my study area.

FY2007 1-3FR Project Research Activity Overview												
2007	4	5	6	7	8	9	10	11	12	1	2	3
Resilience Seminar	13:00-17:00		11:00-17:00	15:30-16:45				15:30-16:45			15:00-16:30	
	23-Apr		20-Jun	30-Jul				22-Nov			15-Feb	
	(17th Seminar)		(18th Seminar)	(19th Seminar)				(20th Seminar)			(21th Seminar)	
Core-mamber Meeting	＊4/23		＊6/20	＊7/19					＊12/17			＊3/8
Workshop		Hamamatsu W				Lusaka WS						Otaru WS
		11-12 May				3-Sep						7-9 March
Study Meeting										＊1/19	＊2/17	＊3/15
Measurement devices	Purchase Order			Delivery	Shipping	Installation, Start of Measurement & Household Survey						
		RainGauge Training: 19-Jul										
FR Project Report											FR Report Publication	
FR Related Meetings	IS Application	7-May			FS Hearing	21-Sep			RIHN Project			FS Hearing
	IS Hearing	17-May							Meeting			6-Mar
									12-14 December			
RIHN Events				RIHN Forum			RIHN Int'l Symposium		Coop In Kyoto		PEC	
				7-Jul			30-31 October				2/28-29	
				KICH			Miel Parque Kyoto					
Field Trip Schedule												
Shijo	3/15-4/18		5/16-6/13				10/20-11/30					3/5-3/24
Tanaka			5/26-6/10					11/2-18				3/14-3/28
Miyazaki						8/31-4/30	(8 months)					
Noro(M1)			5/16-6/13		8/22-9/5		10/6-12/24					
Miura			5/16-6/13									
Shibata			5/27-6/10									
Sakurai	4/2-4/18					9/12-10/12						
Kanno	4/2-4/18					9/15-9/25						
Yamauchi						9/15-9/25						
Shimada			6/16-6/23 (UK)		7/28-8/11						2/20-2/28(S.A., Lesotho)	
Ishimoto (D3)								10/29-1/31 (Burkina Faso)				3/14-3/28
Narisawa(D1)											2/10-3/29	
Ito(M2)	-March											
Nakamura(M2)				-7/11								
Kyo (M1)											2/18-7/26 (6 months)	
Yoshimura					8/22-9/5							
Saeki						8/31-9/26						
Yamashita					8/22-9/5							
Matsumura						8/31-9/28		10/29-11/9				
Umetsu						8/31-9/26						3/19-3/29
Lekprichakul						8/31-10/13			12/26-31(Bangkok)			3/19-3/29
Kume							10/22-31(India)					3/9-3/21(India)
Mwale(Invited Researcher	4/1-6/30	RIHN										
Kajoba(Invited Researcher)							10/1-12/31	RIHN				
Flint (Invited Researcher)											2/4-5/3	RIHN

はじめに

地球研平成１９年度フルリサーチ (FR) 研究「社会・生態システムの脆弱性とレジリアンス」は本プロジェクトとしての一年目を無事終了した。

平成１９年９月には、最初のルサカワークショップを開催し、多くの研究者や実務家の参加を得た。参加機関は、主要研究協力機関であるザンビア農業研究所(ZARI)、ザンビア中央統計局(CSO)、ミシガン州立大学食料安全保障プロジェクト(FSRP/MSU)、JICA ザンビア事務所、ザンビア大学(UNZA) であった。その他にもレジアンスプロジェクトの活動に興味を持った機関も多く、今後それらの機関との研究協力の展開が期待される。

平成１９年度はプロジェクトの研究活動の主要部分を２つのサイトで開始した。東部州ペタウケ郡では、異なる休閑システムが作物収量と土壌に与える影響を調べる実験をスタートさせた。南部州シナゾングェ郡では、大学院博士課程プログラムの一環として２名の大学院生によって村落での長期滞在に基づく調査が 2006/2007 農業シーズンに行われた。またプロジェクト研究員が 2007/2008 農業シーズンに現地滞在し、圃場観測を実施している。彼らの現地での調査はレジリアンスプロジェクトにとって大きな財産である。圃場レベルでの雨量と気象を観測するために、雨量計と気象ステーションが設置され、農業シーズン前の１０月から集中的な世帯調査が開始された。南部州では 2007/2008 年の農業シーズンの前半は大雨に見舞われ、洪水による農作物の被害が懸念されている。衛星データを使った土地利用と植生被覆の歴史的変遷の状況把握と広域世帯調査のデータ分析も進行中である。

２００７年は世界的な原油高を経験した年でもあった。内陸国のザンビアでは当然ガソリンとディーゼルの価格が高騰し、我々はフィールド調査のコスト高に苦しんだ。この原油高は世界史の中で第３次石油危機ともなる可能性があり、途上国経済や農村世帯への影響は今後の課題である。

本プロジェクトは今年度の FR1 の段階を終えた。 1-3FR メンバーの方々にはプロジェクトの調査を開始させるためにご尽力をいただき感謝したい。また地球研のプロジェクト評価委員会 (PEC)、所長、プログラム主幹、管理部のスタッフの方々をはじめ、研究部スタッフの方々にこの様なプロジェクトを実施するためにご支援いただいたことに感謝申しあげる。

平成２０年３月

総合地球環境学研究所
1-3FR プロジェクト・リーダー
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P1－3FR

社会・生態システムの脆弱性とレジリアンス

プロジェクトリーダ： 梅津 千恵子　　**略称**： レジリアンス・プロジェクト

キーワード： レジリアンス，貧困， 社会・生態システム，資源管理，環境変動，脆弱性，人間の安全保障，半乾燥熱帯

１．研究目的と内容

（１）研究目的

・ 研究の背景と目的

貧困と環境破壊の悪循環は森林破壊，砂漠化などの「地球環境問題」の主要な原因である。そのもっとも顕著な例が，世界の貧困人口の大部分が集中するサブサハラ・アフリカや南アジアの半乾燥熱帯であろう。そこでは，天水農業に依存する人々の生活は環境変動に対して脆弱であり，植生や土壌などの環境資源は人間活動に対して脆弱である。この「地球環境問題」を解決するためには，人間社会および生態系が環境変動の影響から速やかに復元すること（レジリアンス）が鍵となる。そこで，本プロジェクトでは社会と生態を一つのシステムとしてとらえ，そのレジリアンスについて半乾燥熱帯を対象に実証的な研究を行う。

・ プロジェクトの最終成果として何を示そうとするのか

本プロジェクトは，社会・生態システムの脆弱性を規定する要因を解明し，システムのレジリアンスを高める方策を提案することで，貧困と環境破壊という悪循環の解決に資することを目的とする。そのために，現地調査に基づきレジリアンスを評価する指標を作成し，その指標を用いて望ましい社会制度や資源管理手法についてのオプションを提示する。

（２）研究体制と研究の内容・方法

・ グループに類の構成と役割

４つのテーマが互いにリンクしながら統合的なレジリアンス評価を行う。

テーマ I　環境変動下での人間活動と生態レジリアンス

テーマ II　不確実な環境に対する世帯とコミュニティーの対応

テーマ III　脆弱性増大のポリティカル・エコロジーとレジリアンス

テーマ IV　社会-生態システムに対する統合解析

・ 対象地域

本プロジェクトは，多くの人口が天水農業地域に住み，環境資源に生活を大きく依存する半乾燥熱帯地域を対象とする。すなわち南アフリカ地域（ザンビア，ジンバブエ等），西アフリカ地域（ブルキナファソ，ニジェール等），及び南アジア（インド等）を調査対象地域とする。特にザンビアを主要調査地とし，旱魃常襲地帯の南部州，東部州をフィールドとする。

・ 研究内容・方法

テーマI　環境変動下での人間活動と生態レジリアンス　(リーダー：真常仁志)

環境変動下における生態レジリアンスと人間活動の相互作用を明らかにする。生態レジリアンスの構成要件，許容量および遷移を評価するため，比較的安定な状態にある生態系が拓かれ農耕地へと転換される途上で起こりうる土壌の劣化，肥沃度メカニズムの質的変化などを時空間変動の観点から追跡する。立地条件，土地利用とその履歴，遷移段階などが異なる農

耕地生態系の比較から，生態レジリアンスが人間活動に与える影響を明らかにする。

テーマII　不確実な環境に対する世帯とコミュニティーの対応　(リーダー：櫻井武司)

農村世帯が不規則な降雨に対して取る戦略を調査する。まず圃場レベルで降雨量の空間・時間分布を測定する。次に旱魃に対処するための世帯の資産状況を調査する。降雨量の変動に対してどの様に作物シーズンの前，途中，後に対処しているのかを分析し，最後に世帯のレジリアンスをリスク管理能力と対処行動の効果によって評価する。

テーマIII　脆弱性増大のポリティカル・エコロジーとレジリアンス　(リーダー：島田周平) 社会的レジリアンスの制度的側面に注目する。社会的レジリアンスは社会・政治・経済の変化のみならず，生態的変遷によって変化する。変化は空間・時間の複数スケールで同時に起こるので，社会的レジリアンスを理解するためにはまず脆弱性増大のプロセスと緩和プロセスを同時に理解することが必要である。

テーマIV　社会-生態システムに対する統合解析　(リーダー：吉村充則/梅津千恵子)

生態システムの変遷とそれに影響を与える社会システムについて統合的かつ包括的な調査を行い，生態システムの脆弱性･レジリアンスと人間活動の相互作用について明らかにする。生態システムの脆弱性がもっとも顕著に現れる「旱魃」を取り上げ，気候･気象的要因と実際の旱魃被害状況について把握するとともに，旱魃によって起こる食料危機に対する早期警戒システムの果たす役割，さらにはこれが人間活動に与える影響について検討する。

（3）地球研のプロジェクトとして

・　何故，地球研のプロジェクトとして実施するのか

地球研のプロジェクトとして研究を実施した場合，今まで他の研究費で実現不可能であった研究内容に挑戦することが可能となる。レジリアンス・プロジェクトでは，森林伐採実験，広範囲での農家世帯調査と圃場レベルの土壌・降雨量データ収集をプロジェクト全期間に渡って実施する予定である。特に社会・生態システムのレジリアンス研究には多分野の研究者の参加が必要であり，地球研プロジェクトとして学際性を発揮したい。

・　「地球環境問題」の認識

環境資源に生産活動を依存する人々は環境変動に対して脆弱な生活を営んでおり，それが貧困と環境破壊の悪循環の原因となっている。この悪循環は重要な「地球環境問題」として認識され，2005 年 3 月に開催された環境開発大臣会議でも特にサブサハラ・アフリカ地域での人間環境に対する地球温暖化の影響調査の必要性が強調された。そこで，本プロジェクトでは国際社会で重要な「地球環境問題」と認識されている半乾燥熱帯地域での環境変動の影響と人間社会のレジリアンスについて考察する。

・　対象地域と「地球環境問題」の関係

本プロジェクトは南アフリカ地域（ザンビア），西アフリカ地域（ブルキナファソ），及び南アジア（インド等）の半乾燥熱帯地域を調査対象とする。この地域では，貧困な人々の人間活動に原因する森林破壊や砂漠化などの地球環境問題が顕著に現れており，その問題解決のため，「人間の安全保障」としての食糧安全保障やレジリアンスの向上，貧困削減が緊急の課題となっている。

・ プロジェクトの成果がどのように「地球環境問題」の解決に資するのか

本プロジェクトでは，社会・経済システムの脆弱性を「地球環境問題」として捉え，脆弱性を規定する要因を解明し，レジリアンスを高める方策を提案することが「地球環境問題」の解決につながると考える。現地での測定，観察，分析を通してレジリアンスの鍵となる指標を検討し，その指標を用いて生態系と資源管理へのオプションを提示する。

（4）「総合性」「学際性」の実現

・ 方法・体制などの特徴と問題点

４つのテーマについて研究を実施し，世帯，地域レベルから歴史的，空間的分析などを相互にリンクさせる。特に自然科学分野の研究者との学際的研究により，科学的情報を社会科学の研究に応用できる研究者の参加を得ている。今年度のプロジェクトへ参画した研究分野は身体計測，人類学，社会学，森林生態学，農業気象学，保健衛生学等。他のプロジェクトとの連携として，同様の研究目的を持つプロジェクトと合同でワークショップを開催する。

（5）具体的提言に向けて

研究成果を本や論文として出版し，ワークショップや国際学会などで発表すると同時にホームページで発信する。IHDP 等の国際的研究コミュミティーに積極的に参加する。ザンビア国内での関係者とのワークショップにより研究交流・議論を深め成果を提言する。

２．進捗状況

（1）今年度までに明らかになったこと（FR1 の成果）

・ 研究体制の構築

－平成 19 年 3 月にザンビア農業研究所（ZARI）と締結した MOU に基づき，東部州と南部州で共同研究を開始した。

－平成 19 年 9 月 3 日に第 1 回ルサカ・ワークショップを開催した。参加機関は，主要研究協力機関であるザンビア農業研究所，ザンビア中央統計局(CSO)，ミシガン州立大学食料安全保障プロジェクト(FSRP/MSU)，JICA ザンビア事務所，ザンビア大学(UNZA）であった。

・ 方法論の検討成果

文献調査およびフィールドでの観察，聞き取り調査によりレジリアンス研究のためにターゲットとするべき調査項目の特定を行った。

・ 平成 19 年度フィールド調査等の成果

－平成 19 年度（FR1）では本格的なフィールド調査のためのインフラ整備として気象ステーションの設置，雨量計の設置，試験圃場の整備，広域世帯調査を実施しながら，11 月の雨期のスタートと供に本格的な調査を開始した。　テーマ I．ザンビア東部州ペタウケ近郊の村に設けた野外試験地において，植生調査・測量作業を実施した。開墾・火入れ作業も行い，試験地におけるメイズ栽培を開始するとともに，気象・土壌環境のモニタリングステーションを設営した。ザンビア南部州では，テーマ II と同一の対象村において土壌調査を実施し，土壌肥沃度評価のための栽培試験を開始した。テーマ II．南部州のシナゾングウェ地区を農業生態の違いから 3 地帯に区分し，それぞれの地帯で調査対象地（5 村落）を選択し，19 年 7 月にセンサスを実施した．次にセンサスの結果に基づき，それぞれの地帯から 16 戸の農家を選び調査対象家計とした。　同 9 月から 10 月に各戸の圃場に雨量計を設置し降水量の

計測を開始するとともに，11 月から毎週の家計調査を始めた。テーマ III. オックスフォード大学で開催された「アフリカにおける環境のレジリアンス、実態、研究」に関するワークショップに参加し，イギリス及びヨーロッパにおける脆弱性とレジリアンスに焦点を絞った研究の推進，その成果の開発援助への適用上の問題点等について調査を行ってきた。また，昨年から現地調査を実施してきた 2 名の大学院生は，ザンビア南部の乾燥地における生業の多様化戦略，出稼ぎの役割に関する研究報告をまとめた。また他のメンバーは干魃常襲地にある南部調査地との比較で選定してある中央州の C 村における調査を継続中である。テーマ IV. 1)大気環境モニタリングのための気象観測測器および雨量計をザンビア・南部州に設置し，観測を開始した（9 月）。また，全球客観解析データおよびザンビア気象局による現地観測データの解析に着手した。2) 昨年度インターネットを用いて衛星データを入手したが，今年度は，これにスケール要素や時間要素を加味して，土地利用変遷調査に有用なデータ入手を試みた。3) 9 月から 11 月にかけて現地調査によって，ザンビア政府やドナーの食糧安全保障に関する資料収集とシナゾングウェ地区（南部州）での食糧援助についての実態調査を行った。4) 9 月の現地調査で 2007 年当初に開始した広域世帯調査世帯を最訪問し，さらに詳しい状況を調査した。地理情報を取り組んだ社会経済調査の分析方法を検討した。

－レジリアンス研究会を今年度は 5 回 (4/23, 6/20, 7/30, 11/22, 2/15) 実施し、浜松ワークショップ(5/11-12)，小樽ワークショップ (3/8)を開催した。プロジェクト HP をスタートさせた。またプロジェクトのワーキングペーパーを発行し、プロジェクト HP で公開予定。

３．今後の活動

（１）FR2 で取り組むこと

・ プロジェクトとしての成果

－調査内容の重点項目を明確化し，今年度中に次年度からの調査計画を作成する。

－テーマごとの文献レビュー・調査計画を作成する。

（２）平成 20 年度の活動内容

－ 1) 本年度開始した栽培試験において収量調査を実施する。土壌環境，雑草などの調査から収量を決定する要因について考察する。栽培試験は引き続いて実施し，干ばつなど気象変動による収量の変動を解析する。2)雨量計の設置を含む家計調査の実施体制を確立した後の観測，世帯調査の継続に対する指導，監督が現地のスタッフとの協力体制のもとで求められる。3)ザンビア中央州における C 村の農民の脆弱性増大に関する継続調査を実施する。今までメンバーが実施した南部州における農村調査を継続し，また新たに別の調査員による長期の住み込み調査を予定している。 4) これまで基盤情報整備として行ってきた衛星データや気象データの蓄積に対して，さらに異なる空間スケールや異なる時期のデータを継続追加整備することとする。ザンビア国内の旱魃時の食料援助に伴う NGO の動きについても調査を継続する。統計情報の入手と分析についても引き続き実施し，さらに世帯調査のデータ分析も実施する。また，他テーマとの連携を目的とする研究についても開始させる。

－2009 年 1 月までに FR2（中間）報告書を作成する。

（３）研究遂行上の問題点と解決策

－観測・調査のためフィールドステーションの設置を今後検討する。

４．年次進行表

	H17 FS	H18 PR	H19FR1	H20FR2	H21FR3	H22FR4	H23FR5
分析手法の確立	xxx	xx	xx	x			
ザンビア							
I. 生態レジリアンス	x	xx	xxx	xxx	xxx	xx	x
II. 環境変動と農家世帯	x	xxx	xxx	xxx	xxx	xx	x
III. 脆弱性と制度･歴史	xx	xx	xxx	xxx	xxx	xxx	x
IV. 広域と統合解析	x	xx	xxx	xxx	xxx	xxx	xxx
インド		x	x	x	x	x	x
ブルキナファソ			x	x	x	x	
国際ワークショップ			x	x			x
報 告 書	FS 報告	PR 報告	年度報告	中間報告	年度報告	年度報告	最終報告

Figure 1. Resilience of Social-Ecological System and Four Themes

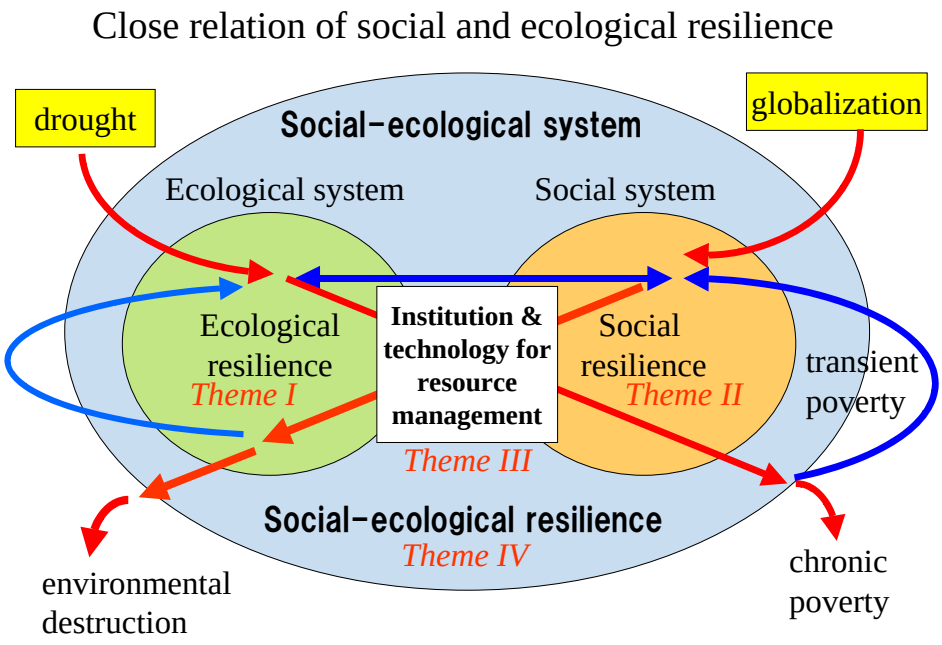

Figure 2. Regions of Semi-Arid Tropics

１－3FRプロジェクトメンバー表 （平成19年度）

	氏名	フリガナ	所属	サブ所属	職名	専門分野	役割分担
ﾘｰﾀﾞｰ	梅津　千恵子	ウメツ　チエコ	総合地球環境学研究所	研究部	准教授	環境資源経済学	地域経済分析・農村調査
A	谷内　茂雄	ヤチ　シゲオ	総合地球環境学研究所	研究部	准教授	数理生態学	アドバイザー
	Theme I						
○	真常　仁志	シンジョウ　ヒトシ	京都大学大学院農学研究科	地域環境科学専攻土壌学分野	助教	土壌資源学	土壌有機物の分解・肥沃度測定
○	田中　樹	タナカ　ウエル	京都大学大学院地球環境学堂	陸域生態系管理論分野	准教授	境界農学	土壌劣化の経時的計測
	柴田昌三	シバタ　ショウゾウ	京都大学フィールド科学教育研究センター	上賀茂試験地	教授	森林生態	樹木構成種調査
	野呂　葉子	ノロ　ヨウコ	京都大学大学院農学研究科	地域環境科学専攻土壌学分野	博士課程前期	土壌資源学	土壌有機物の分解・肥沃度測定
	三浦励一	ミウラ レイイチ	京都大学大学院農学研究科	農学専攻雑草学分野	講師	雑草学	草本群落構成種調査
○	宮嵜英寿	ミヤザキ ヒデトシ	総合地球環境学研究所	研究部	プロジェクト研究員	土壌資源学	土地利用・履歴調査
○	Moses Mwale		Mt. Makulu Central Research Station, Zambia Agricultural Research Station	Ministry of Agriculture and Cooperatives	Vice Director	土壌学	土壌分析
	Theme II						
○	櫻井　武司	サクライ　タケシ	農林水産省農林水産政策研究所	国際政策領域	主任研究官	開発経済学	農村世帯調査
	菅野洋光	カンノヒロミツ	（独）農業・食品産業技術総合研究機構　東北農業研究センター	やませ気象変動研究チーム	チーム長	気候学・農業気象学	気象観測
	山内太郎	ヤマウチタロウ	北海道大学医学部	保健学科	准教授	人類生態学	個人・世帯・集団レベルの栄養と健康の評価
	Theme III						
○	島田　周平	シマダ　シュウヘイ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	教授	環境地理学	農村社会・制度調査
	荒木美奈子	アラキ　ミナコ	お茶の水女子大学文教育学部	グローバル文化学環	准教授	開発学	農村社会・制度調査
	伊藤千尋	イトウ チヒロ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	博士課程前期	人文地理	農村の出稼ぎ労働
	児玉谷史朗	コダマヤ シロウ	一橋大学大学院社会学研究科	総合社会科学専攻	教授	アフリカ社会学	農業生産と社会変容
	中村哲也	ナカムラ テツヤ	京都大学大学院アジア・アフリカ地域研究研究科	アフリカ地域研究専攻	博士課程前期	農業経済	環境変動への農村の対応
	半澤和夫	ハンザワ カズオ	日本大学生物資源科学部	国際地域開発学科	教授	農業経済	農村世帯調査
	Gear M. Kajoba		University of Zambia	Department of Geography	Senior Lecturer	地理学	土地制度と食料安全保障
	Chileshe Mulenga		University of Zambia	Institute of Economic and Social Research (INESOR)	Senior Lecturer	経済地理学	社会行動分析
	Theme IV						
○	吉村　充則	ヨシムラ　ミツノリ	(財)リモート・センシング技術センター		副主任研究員	リモートセンシング	生態変移モニタリング
	飯塚　裕貴子	イイツカ　ユキコ	内閣府国際平和協力本部事務局		研究員	開発学	早期警戒システム
	梅津　千恵子	ウメツ　チエコ	総合地球環境学研究所	研究部	准教授	環境資源経済学	地域経済分析・農村調査
	松村圭一郎	マツムラ　ケイイチロウ	京都大学大学院人間・環境学研究科	文化地域環境論講座	助教	文化人類学	農村社会と土地所有
○	佐伯　田鶴	サエキ　タヅ	総合地球環境学研究所	研究部	助教	大気物理学	気候モニタリング
	山下　恵	ヤマシタ　メグミ	学校法人　近畿測量専門学校		講師	地理情報学	植生モニタリング
○	Thamana Lekprichakul		総合地球環境学研究所	研究部	プロジェクト上級研究員	医療経済学	農村世帯調査・分析
	India						
○	K. Palanisami		Tamilnadu Agricultural University	Centre for Agrl. & Rural Development Studies	Director	農業経済学	農村世帯調査・分析
	谷田貝亜紀代	ヤタガイ　アキヨ	総合地球環境学研究所	研究部	助教	気象・気候学	モンスーン降雨分析
	C.R Ranganathan		Tamilnadu Agricultural University	Department of Mathematics	Professor	数理モデル	社会経済モデル分析
	B. Chandrasekaran		Tamilnadu Agricultural University	Directorate of Research	Director	作物学	米作影響評価
	V. Geethalakshmi		Tamilnadu Agricultural University	Department of Agricultural Meteorology	Professor	農業気象学	モンスーン降雨分析
	Burkina Faso						
	Kimseyinga Savadogo		University of Ouagadougou	Department of Economics	Professor	経済学	家計調査データ分析

○＝コアメンバー; A = アドバイザー

Sinazongwe における気候および気象俚諺

Climate and proverbs of weather forecast at Sinazongwe

菅野洋光（東北農業研究センター）

１．はじめに

2007 年 4 月に、Sinazongwe での調査対象村を選定するために、複数の村で聞き取り調査を行った。筆者は主に気候と気象俚諺(Proverbs of weather forecast)に関する聞き取りを行った。その結果を以下にまとめる。

２．標高・地形と降水量等気象要素との関係

１）**upland(標高 1000m 前後)では相対的に降水が多く、lowland(500m)では少ない。**

Mugilo 村(1018m)で、湖畔から移住してきた人からの聞き取り等、複数の情報から得られた。移住前に住んでいた低地と比較して暮らしやすいとのことであった。

２）**6 月、7 月には霜害が発生し、谷で被害が大きい。**

冬季は最低気温が氷点下になることも珍しく無いようで、特に高標高地域の谷では冷気湖の形成が示唆される｛Sikalindi(1038m) 村、Mugilo 村(1018m)｝。

３．播種計画にとっての雨季の重要性について

雨季に関する聞き取り結果を以下にまとめる。播種とも関係してくるので、雨季の開始が特に重要である。

１）**雨季の開始が遅れることが作物にとってダメージが大きい**｛Sikalindi 村(1038m)｝。

２）**1 月の旱魃が最も影響大である**｛Chande 村(526m)｝。

３）**雨季の開始が非常に重要である。Mugololo の木（写真 1）の開花を播種の雨季のインデックスとして用いている**｛Kanego 村(968m)｝。

４）**10 月に雨が降ると、良い雨季が来るとして upland から耕作をはじめる。10 月と 11 月に雨が降らないと、旱魃と認識して lowland から作付けをはじめる。**

2007 年は 11 月 19 日にようやく雨が降ったので、雨が遅れたと認識して lowland から播種を開始したが、1 月 21 日の洪水で流されてしまった｛Siameja 村(535m)｝。

４．低地における洪水の周期性について

高標高地域に比較して、低地では洪水が問題となっている。

１）**2007 年 1 月 21 日に大雨が降り、洪水となった。低地の農作物は全て流された**｛Lusinga 村(528m) 、Kalanguwa 村(507m) 、Siameja 村(535m)｝。

２）**洪水は 5 年間隔で生じている**｛Lusinga 村(528m) 、Siameja 村(535m)｝。

３）**過去の主な洪水は、 1978 年 1 月（今回と同程度）、1985 年 2 月（小規模）、2003 年 3 月はじめ（小規模）である**｛Siameja 村(535m)｝。

考察）5 年間隔というと、ENSO(El Nino and Southern Oscillation) の 4～6 年周期が想起される。2007 年冬はエルニーニョ的な海水面温度分布であり、オーストラリアの旱魃、インドネシアジャカルタの大洪水(2 月)などが発生した。ENSO とザンビアの降水に関しては、

今後客観解析データ等を用いて解析してゆく必要があろう。

5．気象俚諺(proverbs of weather forecast)の聞き取り結果

気象俚諺に関する聞き取り結果を以下にまとめる。

1）**白い蝶が飛ぶと雨季が近い、黒い蝶が飛ぶと作物の植え時の雨が期待できる**｛Siabunkululu 村(1023m)｝。

2）**アカシヤの新芽が出ると雨季が終わる**｛Siabunkululu 村｝。

3）**風速が強まると雨季が終わる。東風は乾季、西風は強い雨に対応する**｛Siabunkululu 村｝。

4）**風の音が聞こえると 3～4 日後に雨が強まる**｛Siabunkululu 村｝。

5）**9 月から 10 月にかけて、 Mugololo の木（写真 1）から水がたれると十分な雨が降る。**
対策として、もしも木から水がたれなければ、lowland から早めに耕作を開始し、雨が降ったら upland の方へも拡大する｛Sikalindi 村(1038m)｝。

6）**東風の時に雨が降る。風が安定しないと雨にならない。10 月から 11 月に東風が吹き始めると雨季になる**｛Sikalindi 村｝。

7）**11 月に強い雨が降り、そのあと暑さが来ると良い雨季になる**｛Fodowi 村(605m)｝。

8）**2 つの丘の間から風の音(spiritual singing)が聞こえると良い雨が降る**｛Fodowi 村｝。

9）**9 月～10 月に Mutubi の木（写真 2）に新芽が出ると、良い雨季となる**｛Mugilo 村(1018m)｝。

10）**Mugololo の木の開花が穴を開けて種を植える良いインデックスとなる。9 月頃に開花する**｛Kanego 村(968m)｝。

11）**10 月に雨が降ると、良い雨季が来るとして upland から耕作をはじめる。10 月と 11 月に雨が降らないと、旱魃と認識して lowland から planting をはじめる。 10 月の雨を big good rain と考える**｛Siameja 村(535m)｝。

6．気象俚諺の解釈

気象俚諺全てが、年々の気象変動や季節の進行と関係しているとは考えにくいが、中には気象との関係を示唆しているものもある様に思う。以下、解釈をまとめてみた。

1）**木の芽吹きや開花時期、木から水がたれる現象**：大気中の湿度の反映か、土壌水分の影響が考えられる。乾季の散発的な降水によるのか、もっと以前の土壌水分の記憶なのだろうか？

2）**風速・風向による雨季の特定**：大規模場による季節変化の特定が可能なのではないだろうか。

3）**風の音による雨の到来予測**：総観規模の擾乱による短周期の降雨に対応している可能性がある。

4）**雨季のはじめの降水による耕作計画策定**：雨季の開始時期の降水が、雨季全体の降水量とある程度関係している可能性がある。大規模場のその年のパター

写真 1　Mugololo の木

ンが季節開始時期にある程度予測可能かもしれない。特に ENSO との強い関係があるのであれば、その影響はシーズンを通して現れるであろうから、雨季の開始時期の雨量で雨季全体の雨量が推定できるかも知れない。

7．おわりに

2007 年 10 月から開始した気象観測データは、局地的な気象を把握するのに重要であるが、気象俚諺の自然科学的な意味を確認する上でも重要である。気象俚諺がグローバルな気候変動をある程度示唆するのものであれば、手法として全アフリカ的に応用可能であり、さらに調査・検証を進める必要があると考えられる。

写真２　Mutubi の木

生態システムと社会システムの非対称的関係性とレジリエンス研究

島田周平（京都大学大学院アジア・アフリカ地域研究研究科）

Ⅰ．はじめに

環境破壊という言い方は、せいぜいここ 100 年の気候条件が変化しつつあるという意味で正しいが、環境が「壊れる」ということを意味しようとするとそれは間違いである。「壊れた」結果もまた環境だからである。

今日の生態学では、現在の生態環境が 100 年前の状態への復帰力を持っているかという点に関しては否定的である。さらにいえば今後の変化も非線形的な変化をするであろうと考える研究者は多い[1]。そして多くの人々も、現在の環境は後戻りのない変化のようだと考え始めている。それが環境破壊に対する警鐘がノーベル賞につながった一因であったことは間違いない。

ところで環境変化を破壊や脅威と捉える認識は、現在あるいは少なくとも歴史的に記録の残っている過去の気候条件、植生・土壌条件を善しとする合意がなければ成り立たない認識である。たとえば現在その進行が危惧されている気温上昇が、我々に「好ましい」影響を及ぼすと考えられるとしたら、その気温変化はポジティブなものとして歓迎されるであろう。もしかするとそれは「新環境創成」といった呼ばれ方をされるかもしれない。少し過去を振り返れば、森林を切り開き耕地に変えることや天然河川を堰き止めダムを建設する自然改変過程は、開発・発展という文脈でポジティブに評価されることが多かったのである。

我々は「生態的・社会的脆弱性とレジリエンス」を考えるときに、環境の変化が後戻りのない非線形的展開を遂げつつありその変化が我々に様々な脅威をもたらすという環境破壊観を共有すべきであろうか、それとも環境は「壊れる」ことはなく、「壊れた」結果もまた環境だとして議論を進めるべきなのであろうか。

この点は 2007 年 6 月 18 日にオックスフォード大学で開かれた、「アフリカにおける環境のレジリアンス、実態、研究」（Resilience, realities and research in African environment）というワークショップにおいても核心的な論点の一つであった。それは生態学者が考えるレジリエンスの定義をめぐる中で議論が戦わされた。この議論は価値観も関係する大きな問題であるが、新しいパラダイムを求める研究にあたっては、このような研究の枠組みにかかわる大きな問題も丹念に議論を整理しておく必要があると思う。それを自らの課題として受けとめ一定の結論を得た後で新しい地平に進むということが大切である。本論はその様な考えから、極めて荒削りであることを承知の上で、現在考えている研究の枠組みを整理して提起したものである。多くの批判を仰ぎたいと考えている。

枠組みの整理にあたって私は、Berkes, F., Colding, J. & Folke, C. eds. (2003) から多くのことを学んだが、オックスフォード大学でのワークショップでの議論からも幾つかの示唆を得た。とりわけ後者のワークショップからは、より現地における調査や開発実践にいた人たちの切実な意見が聞かれたので考えさせられることが多かった。そのことを明らかにしておくためにも、まず同ワークショップで議論されたテーマの中から著者の問題関心を呼んだ点を幾つか紹介しておきたい。

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[1] Berkes, F., Colding, J. & Folke, C. eds. (2003) Navigating social-ecological systems: Building resilience for complexity and change, Cambridge University Press, 393p.の第 1 章で 3 人の編者は、生態もまた経済と同じく非線形的に変化することが多いことを共通の理解としている。(p. 5)

Ⅱ.オックスフォード大学でのワークショップにおける議論

このワークショップは、アフリカの環境問題に取り組んできた生態学者、人類学者、環境社会学者、援助・開発関係者（国際機関、政府機関、NGO）が一堂に会し、これからのアフリカの開発、研究、政策に対して、レジリエンスという視点からどのような提言ができるのかという目的意識を持って開催されたものである。したがって、議論の比重はレジリエンスの概念規定というよりは、その言葉が持つ政策論的な含意や有効性、さらには今後の発展性におかれていたきらいがある[2]。

しかしそうは言っても、アフリカで起きている様々な環境問題やアフリカに対する援助や開発の問題点が議論されるうちに、専門分野の違いによるレジリエンス概念の多義性がすぐに問題となり、レジリエンス概念の政策論的含意や有効性を議論する前に、概念規定に多くの時間が割かれることになった。以下に取り上げるのは、そんな中で著者の問題関心を呼んだ論点を整理してみたものである。

1.　生態学におけるレジリエンスと閾値問題

このワークショップで報告した二人の生態学者、ジンバブウェで植生と生物多様性との相関関係を調査研究した Graeme Cumming と南アフリカのクルーガー国立公園でサバンナ植生を調査研究している Lindsey Gillson は、レジリエンスは閾値(thresholds)と密接に関連した概念であることを主張した。たとえば Cumming は、生態システムのレジリエンスとは「システムが耐えることのできる範囲内の、またシステム機能と構造のコントロールが同じように維持できる範囲内での変化」(p.8)を意味すると言った。つまり、システムの回復力が失われない閾値内での変化が想定されているのである(模式図 1 参照)。また Gillson は、暁新生時代の植生を調査することによって、劇的なエコシステムの変化が起きた時の生態上の臨界的閾値が分かるかも知れないと述べた。その様な植生の地質年代的変化を追うことによって、現代の森林被覆の最大閾値と最小閾値の推計が可能になるとも述べた。

このような閾値の範囲内での変化をレジリエンスの重要な鍵と考える生態学者たちの報告に対し、多くの社会科学者たちは批判的であった。というのは、その閾値の決定が極めて政治的・権力的問題と関わっており、科学的理由から一義的に決定できないからであるという。これに対し、二人の研究者は閾値の決定に関する生態学的手法の有効性を主張した。しかし、社会科学者たち

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[2] このワークショップの後に発表された報告書では以下の点がレジリエンスと開発に関するメッセージとして掲げられている。
・調査項目を決めるときに政治や権力を考慮することが重要である。そして長期の仕事を支援するために早くから現地の人と接触し政治にも関与することが重要である。
・「より良い状態」のために、レジリエンスに焦点をあてる時には、我々が前提としていることと目指しているゴールを明示的に示す必要がある。そのことが「実態」の認識と政策実行問題とにかかわっているからである。
・レジリエンスという概念は、行為者・機関、動機づけ、能力の役割に光を当てるので、政策立案者や実務家たちにとって魅力的なものであるという意味でポジティブな概念である。
・レジリエンスのアプローチは、社会的ゴールと生態的ゴールとを同時に考えさせるものであり、持続的発展の達成の手助けになる。
Osbahr, H., Boyd, E. and Martin, J. (2007)：*Resilience, realities and research in African environment* (Report of Workshop 18 June 2007, University of Oxford), Oxford, p. 6.

は、政治的・権力的問題抜きに閾値を決めることは不可能であるとあくまで反論した。誰かこの世の中に科学の名を借りた最高管理者が居て、望ましい方向性を示すと言う考え方が過去の歴史を見れば分かるとおり間違いであるという訳である。

しかしその様な意見に対して生態のレジリエンスの閾値問題に長年取り組んできた二人の生態学者たちは、生態学における閾値の概念を利用してレジリエンスの定義をより明確にし、政策立案者たちにも利用しやすいものにすることによってレジリエンス概念の有効性をもっと主張すべきであると述べた。そうしない限り、開発に関係する様々な概念が、新しく提起されてから 5〜10 年以内に消え去ってしまうように、このレジリエンス概念もすぐに顧みられなくなるであろうと危機感を表明した。

2. 社会変化とレジリエンスの関係

生態学者が考える生態学的レジリエンスと社会科学者が考える社会的レジリエンスの間に存在する最も大きな懸隔は 1.の議論とも関連することだが、変化の「行き先」に関する考え方にあると思われる。生態学者が主張する生態的レジリエンスも変化を想定しているが、その変化は生態的機能や構造のコントロールが回復不能な状態に陥らない閾値内での変化である。したがって生態学者の考える生態システムは共生的(symbiotic)な見方に立っていると Ian Scoones は指摘した。彼はこれに対し、社会システムは闘争的であると述べた。

Scoones に限らず多くの社会科学者たちは、科学的な閾値の設定には否定的で、レジリエンスの概念が政治的・権力的磁力から自由ではないことを主張するものが多かった。彼らはまた、レジリエンスが社会変化と不可分の関係にあることも了解している。レジリエンスで議論されるべき重要事は、変化を前提としてその変化をどのようなプロセスで進めるのか、またその変化の目指すべき方向性をどこに求めるのかといった点にあるということになる。

変化のプロセスをめぐっては、漸進的変化(slow change: plaster)か急激な変化(rapid change : revolution)かが議論された。また目指すべき方向性に関する議論では、最も脆弱な集団の脆弱性緩和がレジリエンスにとって重要だという意見や、社会的平等性の保障こそ社会的レジリエンスにとって重要であるといった意見が出され議論されたが、ここでも意見の集約はみられなかった。

著者にとって意外であったのは、社会科学者の多くが生態学者の生態システムのレジリエンスで考えていた閾値の問題を重要視せず、むしろ変化を不可避だと思っていることであった。そこには、現在の社会システムを前提としたレジリエンスは問題外であるという認識が共有されているかと思われるくらいであった。すなわち現在の社会システムはレジリエンス能力によって回復されるべきシステムとは考えられておらず、変革ーおそらくそれを進化や進歩と呼ぶのであろうがーこそが必要だという認識である。問題となるのは、社会の変化を前提とした場合の「回復」能力とはどんなものかという問いかけであるということになる。それが次の 3.における議論に関係してくる。

3. 変化する社会システムのレジリエンスとは

レジリエンスがシステムの変化に対して抵抗するものと考えるのではなく、システムの変化を管理するものであるとする(Keith Lindsay: p.11)意見に多くの社会科学者たちは賛意を示したのであるが、それではその変化するシステムのレジリエンスを保障するものは何かという点に関しては意見の一致がみられなかった。

そこで提起されたのがシステムの「アイデンティティ」である。つまりシステムの「アイデン

ティティ」が保障される範囲の変化はレジリエントであるという理解である。しかしこの「アイデンティティ」も合意を得ることが難しい抽象的な概念である。ストックホルムのレジリエンスセンターの学者は、エコシステムの管理を現地適応的なもの(adaptive management)に変え、さらにはその運営もシステムの変化を前提とした適応的なもの(adaptive governance)に変えるべきだと主張していた。この意見は、システムの「アイデンティティ」を保障するためのより具体的な管理・運営方法について発言したものであるが、この意見に対しても誰が adaptive management や adaptive governance を実施するのかという点で多くの批判があった。つまり、システムの変化を是認するとしてその上でレジリエンスを考えるとすると、どうしてもその変化のプロセスと変化が向かうべき到達点をどのように決めるのかという問題が残るのである。神に代わる管理の方法、すなわち生態・社会システムの変化すべき方向性についての合意形成の方法が求められるのである。

4. レジリエンス概念の有効性と無効性

システムの変化を前提としたレジリエンスを考えるとなると、先述したようにシステムの適切な管理ーそれは社会システムが適応可能なある閾値内での変化プロセスの管理ということになるがーの方法を示し得るかどうかが重要な課題となる。それは、変化を前提とした社会システムの「安定性」[3]を考えることである(模式図 2 参照)。変化を前提とした社会システムの安定性を考えるにあたっては、不確定性やリスク、そしてそれらに対する適応性adaptabilityなどに関する研究が重要となるが、社会科学は未だこの分野での研究蓄積は十分とはいえない。

南部アフリカの牧畜民が住む乾燥地の研究をしている Ian Scoones は、乾燥地におけるレジリエンスを考えるときには、危険性 risk、曖昧さ ambiguity、狭義の不確定性 strict uncertainty、そして無知 ignorance といった「不安定要素 dimension of incertitude」を考えることが重要であると指摘した。しかしこれらの要素に焦点をあてて社会システムの変化の経路やシステムの行き着く先を予測することに社会科学は未だに成功していないと述べている(p.16)。

このように生態・社会システムの変化を前提にしてレジリエンスを考えるということになると、システムの変化経路が一気に複雑なものになり、誰も利用できない概念として放置される危険性すらある。このことを指してある研究者は、レジリエンスの概念に基づく計測可能な指標が与えられない限り、「誰もこの概念を買いに来ないだろう」と発言していたことが印象的であった。

システムの変化を前提にしたレジリエンスを考えることで、単線的な開発発展概念が放擲されることになるのかというと、そこは簡単ではなく、むしろ変化のプロセスと変化の到達点に関する議論の次第によっては、かつて社会主義的発展にみられたような「単線的レジリエンス型発展論」が出てくる可能性があるのである。変化を前提とするといいながら、変化のプロセスと到達点を管理するものの存在を否定する意見が多かったのは、とりわけ自然科学的な方法論による管理の可能性を否定する意見が多かったのは、このような単線的なレジリエンス型発展論に対する反発があったからであろうと思われる。

Ⅲ. 本研究における分析枠組みの提示

Ⅱ.で紹介したワークショップでの議論も踏まえ、ここでは著者が現在考えている生態・社会的

[3]変化の軌跡から逸脱することがない範囲内での回復力が保持されているという意味

レジリエンスの捉え方に関する試論を述べておきたい。オックスフォード大学におけるワークショップでも盛んに言われたとことであるが、生態的システムと社会的システムのレジリエンスを別々に問題とする二分法的分析方法では、これまでの研究視点の枠組みを変えることができない。しかし両システムを一組のものとしたレジリエンスを直ちに考える準備ができていない。とくに両システムの変化を前提としたレジリエンスを考えるということは新しい課題であるといえるので、その前段の作業として生態システムと社会システムにとってのレジリエンスを別々に検討し、その上で両者のシステムの総合的分析方法について考えたいと思う。

1. 生態的システムの変化とその中でのレジリエンス

Ⅱにおけるワークショップでの議論でも紹介しておいたが、方法論的に現在の生態学者にとって、変化を前提にしたレジリエンスの考え方は存在しないように思われる。例えば現在その科学的証明が確立されたかに見える地球温暖化問題一つをとっても、その変化がレジリエントであるかどうかは、人間が判断することであって、生態システムの研究成果から自動的に帰結されるものではない。生態システム研究から提起できる結論は、現在の二酸化炭素増大による地球温暖化が、地球の生態システムにとって不可逆的な変化であるかどうかをシミュレーションによって示唆することが精一杯のところでは無かろうか。しかもその変化のシミュレーションの精度がかなり高まったとしても、予測できる新しい生態システムの均衡点がどこにあるのか観測によって確認するには相当の年月がかかる。つまり、生態システムのレジリエンスを、変化を前提に考えることが理論上は可能でも、観測・調査の結果に基づく検証は不可能であるといえる。さらに、生態システムのレジリエンスは社会的評価の産物であるという社会科学者の見解を考慮すると、生態システムのレジリエンスはほとんど議論の出発点すら見いだせなくなってしまう。

生態システムのレジリエンスとは人間社会の価値判断を入れないようにした上で且つ均衡点回帰型レジリエンスを想定しないかぎり、観測・測定の方法さえ確定できない難しいものであると言わざるを得ない。そこで我々の研究においては、生態システムのレジリエンスは、均衡点回帰を基本とするものと措定して出発するべきものと考えるのである。そのことは、次に述べる生態システムと社会システムとの関係の非対称性といった点からも許される措定だといえる。

2. 生態システムと社会的システムの非対称性

生態システムと社会システムは、二つの円を描いてその間を矢印で結んで相互に影響しあうもの、と考えるには無理がある。Berkes 他編 (2003)でも示唆されているように、たとえば生態システムの変化に対する社会システムの対応と、社会システムの変化による生態システムの変化とは、同様な対応関係ではなく非対称の関係にあるといえるからである。

生態システムの変化に対する社会システムの対応で大事なものは、適応力と自律的組織再編能力、そして学習力であると言われる。これに対し、社会システムの変化に対する生態システムの変化は、個体レベルや個体群レベルでの動植物の適応力や学習力は観察されているものの、システム全体では自然的な変化プロセスと考えられる。従ってその変化は自然科学的手法による分析が可能で、結局は生態システムの変化に関する主たる関心事は、その変化が均衡点回帰型なのかあるいは閾値を越えた位相転移型なのかという点に集中する。

したがって、自然システムの変化に対する社会システムのレジリエンスは、人間社会の制度的・組織的な対応で変えることができる可塑性や可変性を持っていると理解されるが、その逆である社会システムの変化に対する生態システムの対応にはそのような可塑性や可変性は無いと考えら

れる。しかしながら生態システムにはすでに多様性や余剰(redundancy)が備わっており、それが生態システムの回復力を保障しており、全体として社会システムの変化に対する生態システムのレジリエンスに余裕を持たせていると考えられてきた。つまり生態システムのレジリエンスを考えるときの閾値は、社会システムのそれに比べ大きいものと考えられてきた。そこで社会システムのレジリエンスでは社会制度や組織のあり方が問題とされ、生態システムのレジリエンスでは種の多様性や余剰に多くの関心集まってきたのである。

このように、生態システムと社会システムのレジリエンスに見られる非対称性が明らかになると、生態システムのレジリエンスを均衡点回帰型のものとして措定することが、方法論上はもちろんのこと、認識論的にも有意味なことのように思われる。そこで我々のプロジェクトにおいても、生態的・社会的レジリエンスの同時的変化（位相転換的変化）を想定することはせず、生態的システムのレジリエンスでは均衡点回帰型変化を想定し、その中における社会システムの変化とそのレジリエンスを検討するということにするということも許されないことではないと考えるのである。

3.本研究における調査目的、調査方法

以上の議論を前提にアフリカの農村社会システムにおけるレジリエンスを考えるとした場合に、我々の調査の目的、方法はいかなるものとなるのであろうか。

現実に起きる降水量や植生の変化を、ある生態システムの閾値内での変化であると前提として考えると、干魃や多雨は繰り返し襲ってくるリスクと見なすことが可能である。そのリスクに対してどのような制度的組織的対応をするのか、また出現頻度の違うリスクから何を学び次のリスクにどのように備えるのか、そして必要に応じ制度や組織をどのように自律的に再編するのか、といった点が社会システムのレジリエンス研究の目的となる。

これとは逆に、社会システムの変化が生態システムの変化に及ぼす影響に関しては、変化が生態システムの閾値を越えたとしても、それが確認できるまでには時間がかかり、実際に観察や調査によって位相転換的変化を確認することはほぼ不可能であるので、生態システムのレジリエンスは均衡点復帰型のものと仮定して考える方が実際的である。ということは、現実に起きている生態システムの変化が、後戻りのない変化かどうかを調査目的にするのではなく、その変化後の状態が変化前のそれに比べ安定かどうか、あるいはそもそも変化に対して安定的な生態システムとはどのようなものかを追究することが主たる目的となる。

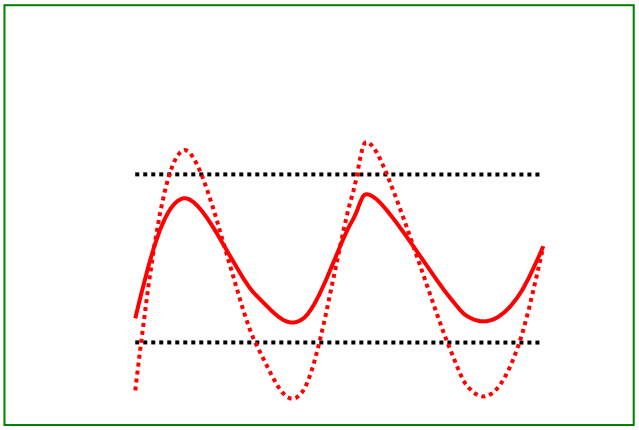
Ⅳ.おわりに

本研究で調査対象として選んでいるザンビア南部の半乾燥地域における生態的・社会的レジリエンスを考える場合にもⅢで述べてきた方法が実際的である。つまり、①「生態システムの変化→社会システムの対応」と、②「社会システムの変化→生態システムの対応」との非対称性を意識しつつ、生態システム側からの調査目的・方法と、社会システム側からのそれとは違ってくることを理解すべきである。

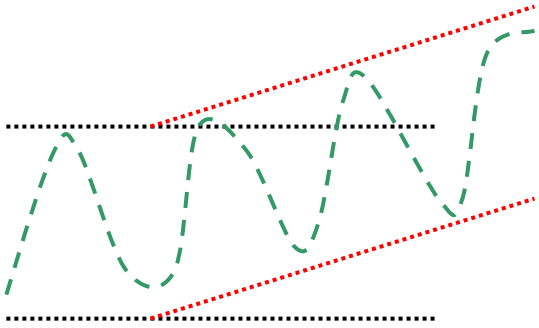
しかし、両者の調査目的・方法が、別個のものとして存在し相互にクロスすることがなければ、これまでの自然科学的アプローチと社会科学的アプローチとの併存状況と何ら変わらない。生態・社会システムの統合的アプローチをねらうためには、②の「社会システムの変化→生態システムの対応」の矢印を逆方向にたどり、生態システムの均衡点回復型レジリエンスを維持するた

めの社会システムの変化とは何かを考える必要がある。そのことは、①の社会システムの対応が、すでに起きた生態システムの変化に対する対応だけではなく、これから起きるかもしれないシステムの変化をも視野に入れた対応であるべきことを示唆している。

このことは社会システムが持つべき学習力と自律的組織再編能力とが、生態システムの変化に対する予知能力とそのレジリエンスを確保するための管理能力とを兼ね備えていなければならないことを意味している。そうすることによって初めて、社会システムが持つ対応力、学習力、自律的再編能力は、生態システムが持つ多様性と余剰を費消し尽くすことなく社会・生態システムのレジリエンスを確保できる可能性が見えてくると考えるのである。



模式図１：均衡点回帰型のレジリエンス
黒の点線：閾値
赤の実線：レジリエントな状態(均衡点回帰型)
赤の点線：閾値を越えた変化(位相を転移することになる)



模式図２：変化を前提としたレジリエンス
黒の点線：均衡点回帰型の閾値
赤の点線：変化を前提とした閾値
緑の点線：変化を前提とした社会システムの変化

サヘル地域の農牧民による出稼ぎ導入とそのインパクトへの対応
－ブルキナファソ北東部Ｉ村の事例から－

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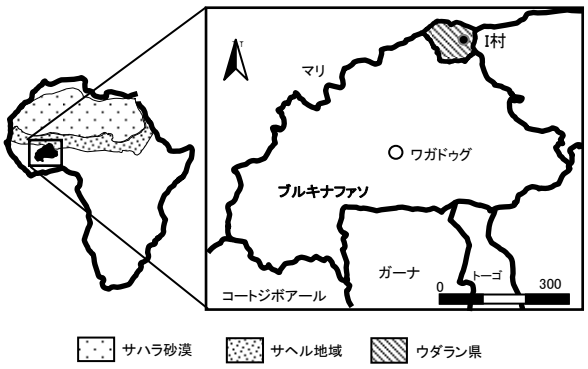
１．　はじめに

旧植民地からの独立以降，西アフリカ内陸国においてサヘル地域からギニア湾沿岸諸国都市部への若年成人男性による出稼ぎ労働が漸次増加している．これは，自然環境によって食料生産が不安定なサヘル地域において家計の安定化に非常に貢献している．しかしその一方で，若年労働力流出によるサヘル地域の生計システムへのインパクトは年々増大している．本研究の目的は，出稼ぎ労働導入の経緯を把握し，それに伴う労働力流失へのサヘル地域の人々の対応を解明することである．本稿は，農牧民タマシェクの暮らすブルキナファソ北東部Ｉ村における事例研究に基づく．

２．　調査概要

現地調査は，2006 年 12 月中旬から 2007 年 2 月中旬および 2007 年 11 月中旬から 2008 年 1 月下旬までの期間，ブルキナファソ北東部のウダラン県Ｉ村にて行った（第１図）．Ｉ村の住人はタマシェク語を話し，農耕・家畜飼養・採集活動を営むと同時に，出稼ぎも行っている．

調査は，期間中に出稼ぎから帰村した者 19 名，およびかつて出稼ぎを行ったことのある者(これを引退者と呼ぶ)の 10 名を対象に直接聞き取りで行った．ただし，調査時には出稼ぎに出かけて不在だった 13 名，過去に出稼ぎを行っていた故人 9 名，さらに他の地に移出していった 4 名の出稼ぎに関する情報も直接聞き取り調査を行った時に得られたので，分析にはこれらの情報も利用した．これらの人々の出稼ぎに関する情報は，出稼ぎ者の兄弟や同時期に出稼ぎに行っていた者からの情報と言うことになる．



第1図　調査地域

主な調査項目は，出稼ぎの期間，出稼ぎ先，出稼ぎ先での職業，そしてさらに出稼ぎ者が出稼ぎ中のＩ村における生業活動のやり方についても聞き取りを行った．

３．　出稼ぎの導入と浸透

本章では，サヘル地域に位置し農牧民の暮らすＩ村において出稼ぎ労働がいかに導入され浸透していったかを解明するため，導入契機・従事者数・出稼ぎ先・出稼ぎ先での職業・労働力流出

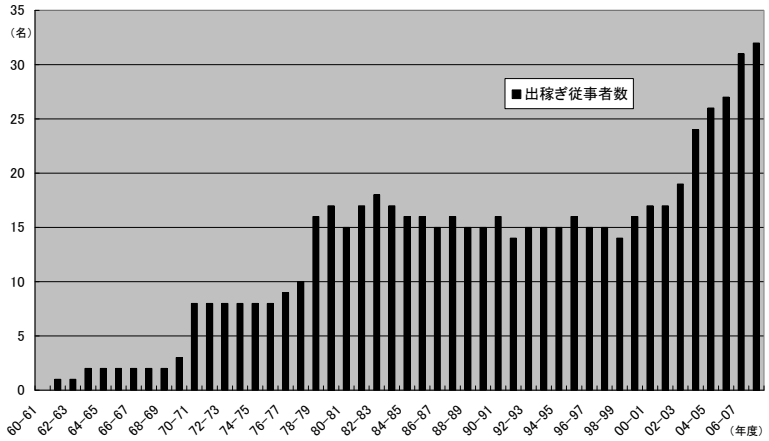
への人々の対応に注目し分析していく．

3－1．出稼ぎの導入契機

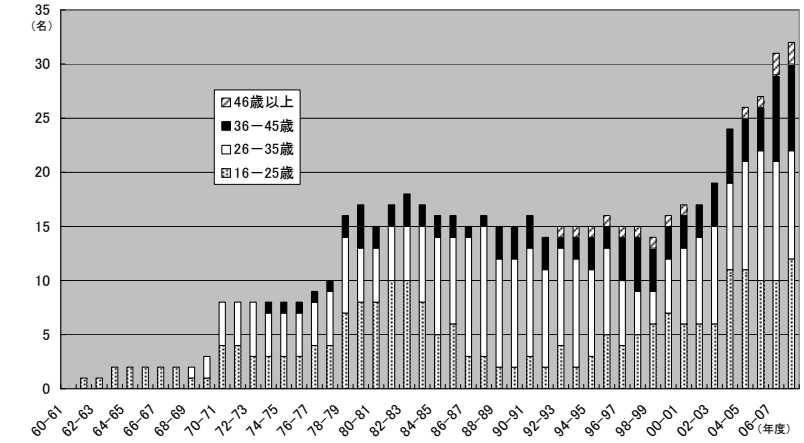
聞き取りによって把握された事例にもとづく限り，Ｉ村における最初の出稼ぎは 1961－62 年の乾季に開始された．この最初の出稼ぎ者は，前年の乾季にＩ村に移住してきた男性で，移入する前から出稼ぎに行っていたという．この村から 1 km ほどの距離に位置する隣村では，1961 年以前から複数の成人男性が出稼ぎに出かけていたという．これらの出稼ぎ者の羽振りの良さ，服装の華やかさに刺激を受け，出稼ぎ労働は徐々に普及していった．

3－2．出稼ぎ従事者数の変化とその背景

出稼ぎは，成人男性の中でも 20 歳弱から 30 歳代の若い世代が中心になって行われていた．第２図に「年度」ごとの出稼ぎ従事者数を示した．ここでいう「年度」とは，６月に始まり翌年の５月に終わる一年である．それは，雨季が 6 月から始まり 9 月まで続き，そのあと乾季が 10 月から翌年の５月まで続くからである．タマシェクの人々は，1 年を雨季に始まり乾季に終わると考えている．第２図より，1960 年代に出稼ぎに行った者の数はごく少数に限られていたこと，1970 年代には急速に増加したこと，1980 年代および 1990 年代には概ね横ばい状態となったこと，2000 年代には再び増加に転じたことが明らかになった．現在生存している人からの聞き取りによる調査結果であるので，出稼ぎ者の数が増加傾向を示すことは当然であるが，ここではその増加割合の変化に注目して以下の分析を行う．



第2図　出稼ぎ従事者数の変化



第3図　年代別出稼ぎ従事者数の変化

まず 1970 年代以降を詳細に分析するため，出稼ぎ従事者数を年代別に分け第３図に示した．Ｉ村では，16 歳から 20 歳の間に成人儀礼を行うため，16 歳未満の男性は出稼ぎに行かない．そこで，16－25 歳を出稼ぎ労働の適齢期に達する年代とし，それ以降を 26－35 歳，36－45 歳，46 歳以上と出稼ぎ従事者を 4 つの年代に区切った．

第３図より 1970 年代に入ると 16－25 歳および 26－35 歳の出稼ぎに出る成人男性が増加し，中でも 1970 年・78 年に伸びが著しいことが判明した．この増加は，1970 年代に入りＩ村におい

て出稼ぎが急速に浸透したことによると考えられた．しかし当時は，出稼ぎに出ることは未だ一大決心を要することであった．1970 年・78 年に参入者が集中したのもその表れの一つで，単独で出稼ぎに行くことができなかった者数名が誘い合って経験者と共に同じ日に出稼ぎに初めて出かけたのである．そののち数年間は，新たに出稼ぎに行く者はいなかった．

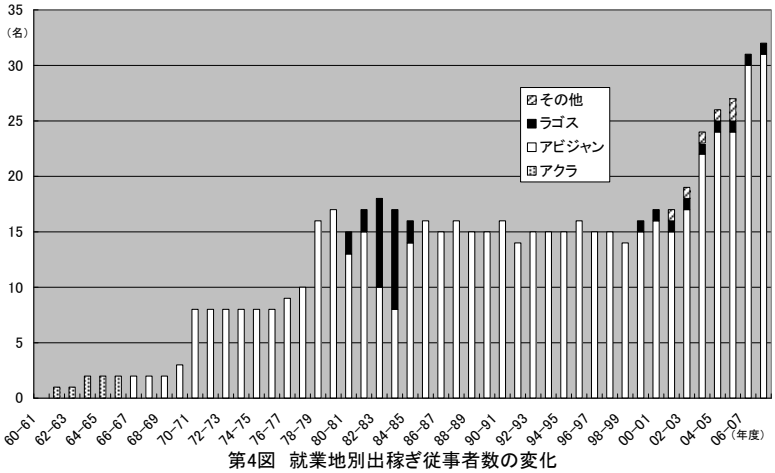
次に 1980 年代を見ると，1982－83 年以降に 16－25 歳の出稼ぎ者が減少し，26－35 歳の出稼ぎ者が増加したことが確認された．これは，1970 年代に出稼ぎに出始めた人たちが 26－35 歳の年齢層に達したこと，その数が新規の出稼ぎ者を上回ったことによる．また，1980 年代中盤から 90 年代初頭までに従事者の総数が減少傾向となっているが，これは結婚を機に出稼ぎをやめる者が増加したことによる．

1990 年代の出稼ぎ者の数を見ると，1980 年代と変わらず横ばい状態にあることが分かる．そして中盤以降に 16－25 歳の出稼ぎ者が増加し，後半になり 26－35 歳の年代が減少しつつ 36 歳以上の年代が増加したことが明らかになった．16－25 歳層の増加は適齢期に達した男性が出稼ぎに行くことがこの頃から一般化したためであり，この時期には 1970 年代・80 年代生まれの男性が適齢期に達した．また後者は，26－35 歳の出稼ぎ者が次の年代に達していったことによる．16－25 歳の年代の増加にもかかわらず総数がほぼ一定となっているのは，参入者と同程度の引退者が出たことによる．

2000 年代に入ると出稼ぎ従事者は増加し続けているが，それは全ての年代が増加したことによる．これは，1990 年代の傾向に引き続き適齢期に達した男性が必ず出稼ぎに出たこと，これまでの出稼ぎ者の継続によって 26 歳以上の各年代に繰り上がる者が増加したことによる．

3－3．出稼ぎ先の変遷

Ｉ村の成人男性による出稼ぎは，最初ガーナの首都アクラであった．数年後コートジボアールの当時の首都アビジャンに出稼ぎ先が移ったあと，一時期ナイジェリアの当時の首都ラゴスに盛んに出稼ぎに行くようになった．しかしすぐに少数の例外を除き大部分の出稼ぎ者が再びアビジャンに出かけるようになり，現在もその状況が続いている（第 4 図）．



第4図　就業地別出稼ぎ従事者数の変化

出稼ぎ労働の開始当初，行き先がアクラからアビジャンへと変わったのは，ガーナにおける通貨移行が契機となったと考えられる．1965 年にガーナの通貨がガーナ・ポンドからセディへ移行し，この時ガーナの通貨はブルキナファソの通貨 CFA フランと比べて価値が急落した．そのため，それ以降出稼ぎ者は労働先をアクラからアビジャンへと変更したのである．その後，アビジャンへの出稼ぎ者は増加し続け，1970 年代末には出稼ぎ従事者が 17 名に達した．

1980 年に，他村に住む血縁者からナイジェリアの好景気を聞きつけた者が，アビジャンからラ

ゴスへと出稼ぎ先を移した．その後ラゴスでの就業者は急増し，最盛期 1983－84 年には出稼ぎ従事者が 9 人に達し，アビジャンへの出稼ぎ者を上回った．しかし，1983 年にブルキナファソ人，コートジボアール人，ガーナ人を対象とした在留外国人追放令[1)]がナイジェリア政府によって発せられると，ラゴスへの出稼ぎを中止する者が相次ぎ，1985－86 年にはラゴスへの出稼ぎ者は 0 人となった．

その後はまれに，ラゴスやブルキナファソの首都ワガドゥグ，リビアのサハラ砂漠地帯などへ出稼ぎに行く者が出たが，それらは単独で行われ，アビジャンが中心的な出稼ぎ先であることには変わりはなかった．2008 年 1 月時点における出稼ぎ従事者 32 名のうち 31 名がアビジャンへの出稼ぎ者であった．

3－4．出稼ぎ先での職業とその動向

出稼ぎ先での職業は開始当初から一貫して都市部における肉体労働や小売業が多かった．これは，Ｉ村の成人男性の大部分が就学歴を持たず，初等教育の修了者が 2 名にすぎないという教育水準の低さと強く関係している．彼らの学歴では公的機関などパーマネントな職に就くことは出来ない．また，ブルキナファソやコートジボアールの公用語であるフランス語を学校教育以外では習得する機会が無いＩ村の人たちのフランス語能力は職を求めるに当たって非常に不利であった．

Ｉ村には長い間小学校に就学する者がいなかったが，1990 年隣村に小学校が建設されてから徐々に就学するものが増え，2008 年１月までに９人が入学した．そのうち 2008 年１月時点での就学者は３名であった．また，中学校への進学者は延べ２名，2008 年現在の就学者は１名であった．小学校建設後も就学者が少ないという現状をみると，学歴が出稼ぎ先での職業の変化に劇的な変化をもたらすことはあまり期待できず，現在の傾向は当面継続すると考えられる．

出稼ぎ先がアビジャン，ラゴス，アクラといった経済的中心地に集中していることは，出稼ぎ者の職業が，学歴や語学力を必要としない単純な職種に特化していることと大いに関係している．つまり，インフォマルセクターの職種の中でも特に参入が容易な仕事に就くため，地域で最大の経済規模を有し，なおかつ景気の好調な都市を出稼ぎ先として選ぶというわけである．

大きな傾向では変化が見られなかったものの，1990 年代に入り一部の職種への集中といる現象が見られるようになった．それは場所を固定した露店での小売業である．2008 年１月時点では，アビジャンへの出稼ぎ従事者 31 名のうち，専業で荷車引きに従事した１名を除き，残り 30 名が露店での販売業に従事していた．

2008 年１月現在，これらの露店はアビジャンのある特定の地区に集中している．この地区におけるＩ村出身者による最初の露店は，Ｎ氏が 1982 年に始めた雑貨および新聞の販売である．彼はそれで成功を収めた．その露店経営を継続するため 1980 年代後半には，Ｎ氏の帰村時には彼の弟が店番をするようになった．そして，彼の引退後も弟たちは交代で露店を経営し続けていた．Ｎ氏とその弟たちの成功以降，露店業を始める者が相次いだ．そしてそれらの露店は，例外なく兄弟やごく近い血縁者によるローテーションで継続的に経営されるようになってきた．

2008 年１月時点で，Ｉ村の出稼ぎ者が経営している露店は 16 店舗[2)]あり，隣接するなど 100m あまりの範囲に密集しているとのことであった．店舗の集中立地によって，１名で数軒の露店を管理することも可能であるため，年長の出稼ぎ者を 1 名残し，若手の出稼ぎ者は頻繁に行商に赴

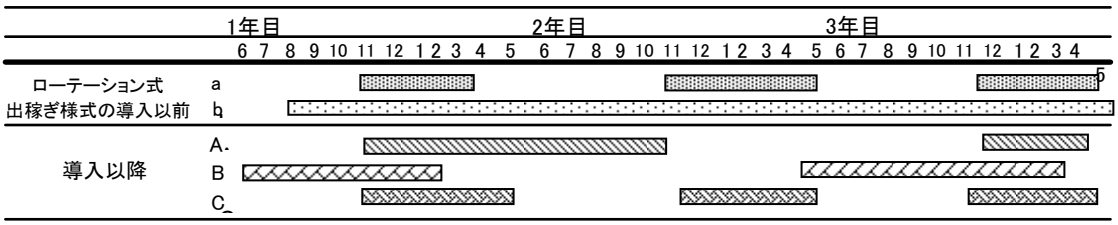
くということも行われた．兄弟で多数の出稼ぎ者を抱えている場合には，複数の店舗を経営する例も見られたという．異なった通りに店舗を設置して同一商品を扱うということでもあり，在庫を共有することで商品のだぶつきを抑えつつ，販売機会の増加を意図しているのだという．また，同一商品を扱う店舗を経営する者は共同で仕入れを行っているという．

2000 年以降，日中は露店での販売を行い，夜には大規模商店やガソリンスタンドの夜警をする者が現れ始めた（2008 年１月現在４名）．夜警の収入は露店業よりも安定し，且つ額でも上回っているため，状況次第では今後もこの兼業形態は増加すると思われる．

3−5．労働力流失への対応

[3]

露店の家族経営は，ローテーションによる出稼ぎ労働の実施を可能にしたことはもう述べたが，このことは村における生業活動の主たる担い手のローテーションにも繋がった．例えば，２名が１年おきに農耕・放牧活動に従事する場合や，そこに乾季のみ出稼ぎ労働を行う者が加わる場合などがある（第５図）．これはすなわち，村における生業活動に軸足を残しつつの出稼ぎ労働が可能になったことを示している．



第5図　出稼ぎ労働の従事期間

それでは，露店経営の浸透によって初めてローテーション式の出稼ぎ労働が実現したかというと，そうではない．出稼ぎ労働開始当初は，経験不足もあり当座の収入を得るために参入の容易な仕事に就く者ばかりであった．そこで，条件の良い職を得た者はその職を手放したくないために，村での生業活動を放擲し，数年にわたり出稼ぎを続ける者も多かった．しかし，出稼ぎが継続的に行われ日常の営みとなるにつれ，村での生業活動を維持しつつ出稼ぎを行おうとする者が出始め，１つの勤め口に交代で従事する者が現れた．ただし，これを実践するには後任人事の決定が可能もしくは左右できるほどの発言力を要するため，1990 年代初頭までは多く見られなかった．その状況が，露店での小売業という自ら経営に携わることが可能でかつ参入の容易な職種の開拓によって一変し， 90 年代中盤に入るとこの様な出稼ぎの方法が急速に浸透してきたのである．

ローテーション式出稼ぎ方法は，一人あたりの出稼ぎ期間が短期間で済み，またその期間の管理も容易であるため，これまで参入できなかった者も出稼ぎに出られるようになった．彼らは，家族の年長者が出稼ぎ労働に出ていた時にひたすら村で農業や放牧を行っていた若者たちである．1970 年代・80 年代生まれの彼らが適齢期に達した時にローテーション式出稼ぎ方法の条件が整い，彼らの多くが出稼ぎに行くようになったのである．また一般に，村を長期間不在にすることが良しとされない既婚者もまたローテーション式出稼ぎ方法の確立で出稼ぎに出ることが可能となってきた．こうして 1990 年代中盤以降には 36 歳以上の出稼ぎ者も増加した．これらの結果として，2000 年代に出稼ぎ者数が急速に増加したのであった．

すなわち，Ｉ村の人々はローテーション式出稼ぎ労働様式を採用することで，積極的な出稼ぎ

労働を行いつつもの村における生業活動のための労働力確保を可能にしたのである．

４．　考察　―出稼ぎ労働の生計システムへの統合―

最後に，ブルキナファソ北東部に位置するＩ村における出稼ぎ労働の傾向を時系列を追って見ていくことで，サヘル地域のある農牧民社会において出稼ぎ労働が浸透して行った過程を概観しておきたい．

Ｉ村における出稼ぎ労働は 1960 年代に始まった．しかし，当初は少数の先駆的若年成人男性による限定的な出稼ぎであった．

1970 年代に入り，適齢期に達した多数の若者が出稼ぎ労働に従事し始めた．Ｉ村の成人男性による出稼ぎ労働への本格的参入が開始された時期であったといえる．

1980 年代には，出稼ぎが日常化し，散発的ではあるが交代で出稼ぎに出る者も現れ始めた．ローテーション式出稼ぎ労働が開始された時期といえる．しかし，多くの者は村における生業活動を中断して出稼ぎに出るという形をとっていた．

1990 年代になると，出稼ぎ先での仕事が露店商に集中しはじめ．それに伴いローテーション式出稼ぎ方法が浸透してきた．これによって，出稼ぎが容易になり後進の若者や既婚男性の継続的出稼ぎが開始されることになった．

2000 年代に入ると，出稼ぎ労働を開始する者が引退者を上回り，出稼ぎ者数が急速に増加しはじめた．また，露店での小売業を継続したまま，他の職種にも進出する者が現れ始めた．出稼ぎ労働が定着し成熟した時期だといえるであろう．

以上をまとめる．出稼ぎ労働の開始当初は，村における生業活動と出稼ぎ労働は切り離された存在であった．すなわち，出稼ぎ労働を行う場合には村での生業活動は中断せざるをえず，出稼ぎ者の増加は労働力の流出に直結していた．当時は，出稼ぎを制限されていた後進の成人男性によって，農村部の生計システムはかろうじて維持された状態であった．

関連性の薄かった，村における生業活動と出稼ぎ労働を１つのより大きな枠組みの中での生計システムとして統合することを可能にしたのは，ローテーション式出稼ぎ方法の創出とその実践に適した出稼ぎ先での職の開拓であった．これにより，未婚の成人男性はもちろんのこと既婚男性も含めた成人男性全体による長期的出稼ぎ体制が確立されたといえる．

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1) Titinga Frédéric Pacere (2004) Burkina Faso: Migration et droits des travailleurs 1897-2003, UNESCO, Paris

2) 交代での露店経営は，１店舗を２名で行う場合だけでなく，１店舗を３名で行う場合や２店舗を３名で行う場合，他村の血縁者が参画している場合も確認された．

ザンビア農村社会の脆弱性とレジリアンス – 土地所有制度と食料安全保障の観点から

Gear M. Kajoba
（ザンビア大学）

＜要旨＞
ザンビアにおいて植民地前の農業システム生態系は持続的かつ環境状況に対しレジリアントであり、よって在来の土地所有制度の下で食料安全保証を確保することが可能であった。しかし、労働移動と土地分配の植民地政策は、Bemba のチテメネシステム、Lozi の氾濫原での耕作等、ある民族グループの生産システムにマイナスの影響を与え、特に農村地域における男性不在により脆弱性が非常に高まった。一方、ザンビア南部のトンガでは、近代的耕作技術の導入に積極的に対応し、ハイブリッドメイズや牛耕を利用、適応することでレジリアンスを示した。また土地制度も在来のミュニティによる所有制度から個人所有へ変化している。

１９６４年の独立以来、UNDP 政府は強力に地域開発を推し進め、メイズ生産に対する補助により、植民地政府の土地制度を維持する保守的政策を実施した。しかし、食料安全は保障されず、政策は小規模農民とメイズ生産に過度に依存し、他の食料作物を軽視する結果となった。

MMD により１９９１年から２００１年までに実施された新リベラル政策は、天候の不順にも災いし、政策と環境変動に対して食料生産システムを脆弱性にした。しかし、２００１年以降現在に至るまで、土地所有のエンパワーメント政策により、土地所有を男性と女性に保証し、地域社会のレジリアンスを再構築するために部分的補助による政府の介入政策が行われており、国家と世帯の食料安全保障を推進する努力が実施されている。

テーマ IV - 2「土地利用変化と生態システムへの影響モニタリング」2007 年度活動報告

山下　恵 (近畿測量専門学校)
吉村充則 ((財)リモート・センシング技術センター)

2007 年度、テーマ IV - 2 では、昨年度実施した予備解析結果に引き続き、時系列衛星画像を用いた植生・土地被覆モニタリング手法の確立を目的として、2006-2007 年に実施した現地調査資料の GIS データベース構築ならびに時系列衛星画像の入手を行った。また、2007 年 8 月下旬には、テーマ I が設置した土壌調査サイト(Mwelowa village, Petauke district)における地形測量作業を共同で実施した。

GIS データベース構築では、ESRI ジャパンの協力の下、POS system(屋外調査支援システム)を使用して、現地調査にて収集した簡易 GPS の緯度経度座標・年月日・時刻・土地利用/被覆項目・聞き取り等のメモ・調査場所で撮影したデジタル写真を、GIS データ(ポイント)として自動生成した。これにより、現地で収集した多量の情報検索や、調査した時期の土地利用/被覆を容易に閲覧でき、さらに、継続して収集される同様の現地情報資料をデータベースに追加・更新することを可能にした。また、2007 年 3 月に実施した現地調査結果からは、カリバ湖畔の水位は、雨期終り頃から乾期にかけて徐々に上がることが分かった。水位が下がって地表が現れた空間には草地が広がり、家畜を放牧している光景が所々見られた。

土壌調査サイト(全域約 200m 四方)における地形測量では、先ず、トータル・ステーション(TS)を用いたトラバース測量により、17 点の基準点を設置した。その後、サイト内に設定された耕作/休閑試験区画(1 区画およそ 30m x 73m)の 4 区画分について、開墾後の火入れ前状態における微地形およびアリ塚や切り倒した樹木の幹や枝などの分布図作成のために、基準点に TS を据え、相対標高および地物の 3 次元位置座標(x,y,z)を測定した。さらに、調査サイト全域の大まかな地形を把握するために、3 本の縦断線測量を行った。これらの結果、調査サイトの地形的特徴として、東から西にかけて低くなる非常に緩やかな斜面を呈していることが分かった。耕作/休閑試験区画内の地形測量は、今後も引き続いて実施される予定である。

植生・土地利用/被覆モニタリングのための時系列衛星画像については、LANDSAT 衛星シリーズに代表される地上解像度約 30m 程度の光学センサによる観測データを、様々な衛星データアーカイブから検索・入手した。検索対象範囲は、Sinazongwe district ほぼ全域とした。また、観測年については 1972～2005 年までの農業的気象的旱魃が報告された年と正常年を区分し、季節については乾期(7-10 月)、雨期(11-3 月)、収穫期(4-6 月)に区分し、データ有無およびデータ品質について調べた。その結果、入手可能な光学センサは Landsat 衛星搭載の MSS, TM, ETM と Terra 衛星搭載の ASTER に限定されたが、観測年と季節については、2001/2002 年(旱魃年)、2003/2004 年(正常年)、2004/2005 年(旱魃年)における乾期・雨期・収穫期の 3 時期以上を含む時系列画像データセットとして入手することができた。

2008 年度では、現地調査での情報収集による GIS データベース更新ならびに時系列衛星画像解析を実施し、旱魃年と正常年における植生・土地被覆の季節変化の違いや、地形条件を考慮した村の分布位置と土地利用形態との関連について調べていく予定である。

IV-3 早期警戒システムと食料安全保障－2007 年度調査報告－

松村圭一郎（京都大学大学院人間・環境学研究科）

１．　研究の目的

アフリカの旱魃など食糧危機を引き起こす政治的・社会的要因を分析するとともに、旱魃・食料危機に関する「早期警戒システム」が、農村社会のレジリアンス・フレームワークに与える影響をあきらかにする。

２．2007 年度の調査概要

2007 年度は、9 月～11 月にザンビアの首都ルサカおよび南部州において、ザンビアの食料飢饉の歴史的変遷、政府・国際機関・援助団体などが行う旱魃対応や食糧援助に関する資料収集と現地調査を行った。主な調査対象の概要は以下の通りである。

＜首都ルサカ＞

- CSO：Vulnerability Assessment Committee（VAC）の脆弱性評価調査に参加した職員へのインタビューと資料収集
- FAO：Emergence Coordinator、VAC 調査メンバー／Programme Against Malnutrition (PAM)メンバーへのインタビューと資料収集
- Disaster Management and Mitigation Unit (DMMU)：Coordinator へのインタビューと資料収集
- University of Zambia（UNZA）／Institute of Economic and Social Research (INESOR)：ザンビアの旱魃・食糧危機に関する歴史研究資料と関係機関のレポート等の収集

＜南部州・シナゾングウェ地区＞

- DACO オフィス：2004／05 の旱魃後の被害状況や食料援助に関するインタビューと資料収集
- Kalilu Development Foundation (KDF)：マネージャーや職員へのインタビューと資料収集
- World Vision International‐シナゾングウェ・オフィス：Relief programme officer へのインタビュー
- シナゾングウェ地区・キャンプオフィサー（Nkandabwe・Siameja）へのインタビュー
- 世帯調査・雨量計設置村落（Siameja、Sianemba 、Chanzika、Kanego、Siachaga）での予備的調査
- シナゾングウェ地区南部への広域調査（Maamba-Siameja-Kafambila）

３．　調査結果の概要

ザンビアの食糧危機に関する歴史研究資料からは、ザンビアが 19 世紀よりたびたび食糧危機に見舞われてきており、その原因も、雨量不足による旱魃だけでなく、民族間の紛争やレイディング、戦時の徴兵や鉱山開発にともなう労働不足といった社会・政治的な要因が関わってきたことがあきらかになった。また、20 世紀初頭の植民地期より、外国のキリスト教系のミショナリーや政府が主導した食料危機への対応がはじまっていたものの制度的・資金的な限界が大きかったこともわかった。また、そうした外部からの援助が展開するようになったことで、ローカルレベルの食糧危機への自発的対応（救荒植物への知識・首長主導の援助など）が失われてきた可能性も指摘されていた。

シナゾングウェ地区で集中的に調査した 2004／05 の旱魃への政府やローカル NGO などの対応からは、さまざまな異なる組織が独自の基準をもちながら食糧援助を行っている実態があきらかになった。2003 年ごろから本格的に組織化が進められた副大統領府（OVP）の Disaster Management and Mitigation Unit（DMMU）と、その末端で効率的な援助を指揮している District Disaster Management Committee（DMC）が、この 2005 年から 06 年にかけてのシナゾングウェ地区の食糧危機において、頻繁な会合をもちながら各援助組織の関係を調整していることもみえてきた。ただし、会合の議事録などからは、各組織の地域的な役割分担などは比較的うまく進められているものの、それぞれのターゲットや手法の違いから、どこまで食料を必要としている地域や人々に援助が行き渡っているのか、意見の対立や不透明な部分も多いことがみえてきた。

４．　今後の課題と調査計画

2008 年度は、2007 年度の調査結果をふまえながら、さらにシナゾングェ地区における各組織の援助活動や食料配給の実態を調査していく。政府機関をはじめ、各援助組織がどのような援助計画を策定し、実行に移しているのか、そして、それらの個々の計画がローカルのコミュニティレベルにおいて、どのように受容されているのか、現地調査をもとに明らかにしていきたい。とくに、DMMU 主導で進められている、食料配布の末端組織（サテライト・コミッティー）がどれほど効果的に援助の実施に関与しているのかが、ひとつの焦点となる。

2005/2006 年農作期における RIHN 農家世帯調査

総合地球環境学研究所
Thamana Lekprichakul

2005/2006 年農作期に実施された RIHN 農家世帯調査 (RIHN Agricultural Household Survey: RAHS)の主な目的は、気候の変動に対する自給的農民の脆弱性とレジリアンスを評価することにある。調査は東部州と南部州の 59 箇所の標準調査区 (Standard Enumeration Area: SEA)に渡り、総計 1,015 世帯を対象に実施した。このクロスセクション世帯調査の特徴として挙げられるのは、ザンビア中央統計局の 2003/2004, 2004/2005 農作期の収穫後調査(Post Harvest Survey: PHS)と組み合わせると３年間のパネルデータとなることである。さらに、世帯調査は収穫後調査が網羅する調査項目の範囲以上をカバーしていることである。穀物、野菜、果樹の生産、販売、ストック、生産要素に関する情報に加え、RAHS では農民の農業および農外収入、送金、資産保有状況、食料消費、貧困状態、リスクとその対処行動に関する質問をしている。調査はザンビア中央統計局(Central Statistical Office: CSO)によって実施された。

調査チームよって標本抽出されたサンプル農家世帯への再訪問の結果、農民は農業生産高とその他の収入源を過小に評価する傾向があることが明らかになった。特にこの傾向は国境の近くに居住する農民では顕著であった。さらに、我々がランダムに実施した農家インタビューでは、調査員は情報を正確に記録していた。しかし、ある世帯に対するインタビューでは質問票の主要部分での欠落があり、それは修正された。この調査の問題点は、調査が質問対象とする年の１年後にこの調査が実施されたため、回答者の記憶の間違いが起る可能性が高いことである。全般的に、RAHS の調査の質は満足の行くものであり、パネル調査であることから調査員が質問を怠る動機が少ないと考えられる。データの質に関しては問題ないものの、改善の余地はまだかなりある。

タミルナドゥ州の異なる農業気候地域のための気候変動に関連する複合脆弱性指標の開発

Developing the Composite Vulnerability Index relating to Climate Change for the Different Agro Climatic Regions of Tamilnadu

K.Palanisami[1], C.Ranganathan[1], S.Senthilnathan[1] and Chieko Umetsu[2]
([1] タミルナドゥ農業大学, [2] 総合地球環境学研究所)

要旨
インドの農業は気象、特に降水量の変動に大きく影響を受ける。インド亜大陸の降水量の８０％は６月から９月の３ヶ月間に起こり、南西モンスーンとなる。旱魃がある地域で問題となる一方、洪水も別の地域で人間生活と農業にとって被害を及ぼし、平均的に氾濫しやすい土地の約３分の１は農地である。洪水となる過剰な雨量、不作をもたらす旱魃、財産に損害を与えるサイクロン等、気候の負の影響へは迅速な対応が求められる。その時々に気候の影響に対する社会の対処能力が試される。歴史的に社会の対処能力は地域的に試されてきており、社会は気候の変動にレジリアンスを持つ様に適応してきた。

脆弱性とはその地域にすむ人口の経済システムの状態であり、また社会経済的な特徴でもある。本稿では、脆弱性の社会経済的な観点から、地域の発展段階およびさらに発展する能力を計る指標に焦点を当てた。Anand and Sen (1994)によって人間開発指標(Human Development Index: HDI)を計算するために開発された脆弱性指標の方法を基本とし、人口の脆弱性、気候の脆弱性、農業の脆弱性、就業の脆弱性を含めた。タミルナドゥ州の異なる農業気候地域で 1980-2001 年までの３期間の指標を７地域で比較した結果、高降水量地域が一番脆弱性が高いことが明らかになった。脆弱性指標は、脆弱性をモニターし、脆弱性を低下させるための対策を開発し、優先順位を考え、またそれらの対策の効果を検討する際に潜在的に有効な方法であろう。

統合研究の研究組織―地球研・流域プロジェクトの経験から

梅津千恵子（総合地球環境学研究所）
谷口真人（総合地球環境学研究所）
渡邉紹裕（総合地球環境学研究所）
谷内茂雄（総合地球環境学研究所）

地球環境問題を解決するための異なる分野からの統合知 (consiliece) の重要性は研究や行政に携わる者によって長い間議論されてきた。実社会での問題の本質が複雑になればなるほど、環境問題の分析・解決のための統合的アプローチに対する社会的要請が高まる。流域は生態系の地理的境界であり、社会および経済的活動を地域スケールで支える基盤である。流域の環境問題には多面的要素が含まれる。統合的プロジェクト研究は学際的研究への新しい活動の場を提供するものである。研究の概念、方法、地理的対象地域等によって統合することが可能である。

統合的プロジェクト研究の研究組織を比較する試みを行った。対象としたプロジェクトは「乾燥地域の農業生産システムに及ぼす地球温暖化の影響」、「琵琶湖―淀川水系における流域管理モデルの構築」、「都市の地下環境に残る人間活動の影響」の地球研３流域プロジェクトである。これらのプロジェクトでは、それぞれのプロジェクトのミッションおよび統合的目標を遂行するための研究組織が形成されてきた。統合には、空間、時間的変化の比較、指標の作成、結合モデルの開発、研究者間のコミュニケーション等さまざまなツールが用いられた。流域管理のためには、科学的知識を結合する他、流域の科学的知見を伝えるためにステークホールダーとの学際的コミュニケーションが非常に重要である。

レジリアンスプロジェクト第2回ワークショップ

日時：　平成１９年５月１１日（金）14:00-18:00　５月１２日（土）8:30-17:00

場所：　カリアック（商工会議所福利研修センター）

〒431-1207 静岡県浜松市村櫛町４５９７

Tel: 053-484-4155/Fax: 053-484-4150; URL: http://www.curreac.co.jp; E-mail: gd@curreac.co.jp

プログラム（発表 10 分、質疑 10 分）

５月１１日（金）カリアック第 11 研修室

14:00-14:15　受付

14:15-14:30　開会の挨拶・レジリアンスプロジェクトの経過説明

「社会・生態システムの脆弱性とレジリアンス」

（司会　梅津）

14:30-14:50　インドタミールナドゥの降水変動

谷田貝　亜紀代　（地球研）、V. Geethalakshmi（タミルナドゥ農業大学）

14:50-15:10　津波による土壌および地下水の塩性被害からの回復

久米　崇　（鳥取大学乾燥地研究センター）

15:10-15:20　休憩

（司会　真常）

15:20-15:40　ザンビア東部州ミオンボ林における土壌特性値の空間変異

野呂　葉子　（京都大学大学院農学研究科）

15:40-16:00　生業技術の把握とその多様性の評価

宮嵜　英寿　（地球研）

16:00-16:20　適正技術のための土壌管理オプションの融合

Moses　MWALE（ザンビア農業研究所 (ZARI)）

（司会　LEKPRICHAKUL）

16:20-16:40　農家家計の脆弱性の決定因：ブルキナ・ファソの事例

櫻井　武司　（農林水産政策研究所）

16:40-17:00　シナゾンウェにおける気象観測計画

菅野　洋光　（東北農業研究センター）

（司会　島田）

17:00-17:20　半乾燥地域サヘルにおける食料危機への対処行動に関する考察

－ブルキナファソ北部における事例－

石本　雄大　（京都大学大学院アジアアフリカ地域研究研究科）

17:20-17:40　ローカルな権力による制約下での生業戦略
－ザンビア西部のカラハリ・サンドに生きるアンゴラ移住民の事例－
村尾　るみこ　（京都大学大学院アジアアフリカ地域研究研究科）

18:00-　テーマごとの打合せ（各自）

19:00-21:00　懇親会　（カリアック内）

５月１２日（土）浜名湖国際頭脳センター　212 号室（Tel：053-484-4000）
（司会　梅津）
8:30-9:30　ビジネスミーティング
現地での測器展開とテーマ間連携について

9:30-10:30　テーマごとの進捗状況報告と今年度の研究計画
テーマ I「環境変動下での生態レジリアンスと人間活動」
真常　仁志　（京都大学大学院農学研究科）

テーマ II「農家家計は雨期のいつ、どのようにしてショックを予見するのか：
ザンビアにおける詳細家計調査のデザイン」
櫻井　武司　（農林水産政策研究所）

テーマ III「脆弱性とレジリアンスに関するポリティカルエコロジー：
歴史的・制度的観点から」
島田　周平　（京都大学大学院アジアアフリカ地域研究研究科）
テーマ IV「社会-生態システムに対する統合解析」
吉村　充則　（地球研）

10:30-10:40　休憩

（司会　島田）
10:40-11:00　ザンビアの農業生産と土地利用
半澤　和夫　（日本大学農学部）
11:00-11:20　ザンビア食糧安全保障に影響を与える経済的、社会的要因
児玉谷　史朗　（一橋大学大学院社会学研究科）

（司会　吉村）
11:20-11:40　環境変動のグローバルモニタリング
佐伯　田鶴　（地球研）

11:40-12:00　土地利用変化と生態システムへの影響モニタリングのための予備解析
山下 恵　（近畿測量専門学校）

12:00-13:00　昼食

13:00-13:20　食糧危機の政治的・社会的要因：旱魃の早期警戒指標に関する予備調査
松村　圭一郎　（京都大学大学院人間・環境学研究科）

13:20-13:40　2004/2005 年農作期収穫への旱魃の影響
Thamana　LEKPRICHAKUL　（地球研）

13:40-14:00　広域世帯調査の概要と空間情報との融合の可能性
梅津　千恵子　（地球研）

14:00-14:20　データの空間利用・空間解析とデータ統合
吉村　充則　（地球研）

14:20-15:20　総合討論

15:20-15:30　休憩

15:30-16:00　１．年間研究計画・旅行計画
２．予算計画（梅津）
３．出版物に対する謝辞、学会発表での謝辞について
４．ＨＰとロゴの作成について(佐伯・LEKPRICHAKUL)

16:00-17:00　プロジェクトに関する事務手続の説明
１．国内出張・海外出張手続き・精算方法（入江、梅津）
２．野外調査計画書、地球研の団体保険について（梅津）
３．調査許可について（梅津）
４．その他（梅津他）

17:00　閉会

17:30　バスで舞阪へ移動

レジリアンスプロジェクト小樽ワークショップ

日程：２００８年３月８日 8:00-18:30

会場： 小樽グランドホテルクラシック・クラシックホールhttp://y.gnavi.co.jp/102766/

〒047-0024 小樽市色内１丁目８番２５号　TEL.0134-25-9900 FAX.0134-25-9700

プログラム

8:00- 9:00	テーマ別会議
9:00-9:15	「今年度プロジェクト活動のまとめと来年度計画」 梅津千恵子（地球研）
9:15-9:45	「都市における出稼ぎ労働者の実状―都市と農村の紐帯に着目して」 伊藤千尋（京都大学大学院アジア・アフリカ地域研究研究科）
9:45-10:15	「サヘル地域の農牧民による出稼ぎ導入とそのインパクトへの対応－ブルキナファソ北東部Ｉ村の事例から－」 石本雄大（京都大学大学院アジア・アフリカ地域研究研究科）
10:15-10:45	「脆弱性の視点から見るアフリカ農村発展」 島田周平（京都大学大学院アジア・アフリカ地域研究研究科）
10:45-11:30	Applied research and socio-ecological resilience: social learning, people-driven development and climate Lawrence Flint　(ENDA and RIHN)
11:30-12:00	テーマ１「環境変動下での人間活動と生態レジリアンス」における研究の進捗状況」　田中　樹（京都大学大学院地球環境学堂）
12:00-13:00	昼食
13:00-13:30	「ザンビア旱魃常襲地帯における農民のリスク管理」 櫻井武司（農林水産政策研究所）
13:30-14:00	「ザンビア農村部における子どもの栄養状態・成長モニタリング調査」 山内太郎（北海道大学医学部保健学科）
14:00-14:30	「ザンビア南部における降水量変動と ENSO シグナル」 菅野洋光（東北農業研究センター）
14:30-15:00	「ザンビア南部州の気象ステーション設置報告」 佐伯田鶴（地球研）
15:00-15:15	休憩
15:15-15:45	「植生・土地利用被覆モニタリングのための衛星画像解析と現地調査計画」 山下恵（近畿測量専門学校）・吉村充則（(財)リモートセンシング技術センター）
15:45-16:15	RIHN Agricultural Household Survey Report, 2005/2006 Lekprichakul Thamana (RIHN)
16:15-16:45	「統合研究の研究組織：地球研流域プロジェクトの経験から」 梅津千恵子（地球研）
16:45-17:30	総合討論
17:30-18:30	コアメンバー会議

平成１９年度レジリアンス研究会要旨

第17回レジリアンス研究会

日時：２００７年４月２３日（月）15:30-16:45
場所：地球研セミナー室１・２
タイトル：「アフリカの生態環境と人口扶養力」
発表者：荒木　茂（京都大学大学院アジア・アフリカ地域研究研究科 教授）

[要旨] アフリカ大陸の人口分布は，地域の生態環境に根ざした在来の生業，農業に依存して著しく不均一であり，ザンビア南部州における干ばつに対する自然的，社会的レシリエンスを考える場合も，地域農業の実態把握が不可欠である．これまでにおこなったタンザニア，ザンビア，ナミビアの生態環境と農村調査をもとに，耕地の拡大と人口の動態がどのような状況にあるのかを概説し，ザンビア南部州の農業理解の一助とする．

第１８回レジリアンス研究会

日時：2007 年６月 20 日（水） 15:30-16:45
会場：地球研セミナー室３・４
タイトル：適正技術のための土壌管理オプションの融合と環境変動下での生態レジリアンス
発表者: Moses MWALE (Zambia Agricultural Research Institute)

[要旨] 食料へのアクセスの不足と食料供給量の不足はアフリカでの主要な問題であり、人間の福祉と経済成長のための基本的な課題である。低農業生産は、低所得、栄養不足、リスクへの脆弱性、エンパワーメントの欠如をもたらす。アフリカ開発のための新パートナーシップ(NEPAD)は、食糧安全保障と持続的国家経済を確保するために年間平均６%の農業生産性の増加が目標である。土地荒廃と土壌肥沃度の枯渇、すなわち土壌養分の枯渇が、半乾燥熱帯(SAT)での食糧安全保障と自然資源保全に対する大きな脅威であるとかんがえられている。アフリカでは、農民に経済力を与えること、効率的で、有効な、手頃な農業技術を用いて持続的な農業集約化を推進することによって、貧困と土地荒廃の間にあるサイクルを壊すことが必要である。そのような手頃な管理システムは貧しく、小規模な生産者にとって利用しやすく、そのアプローチは技術的、制度的な変化を促進するために全体論的でありダイナミックでなければならない。　本論文は、ザンビアでの土壌とその管理に基づく知識を普及することが目標である。土壌保全と保全型農業の問題を含んでいる。主な取り組みは、１．土地荒廃を軽減するのに利用可能な技術を棚卸しすること、そして農民参加型アプローチから農民の事情を踏まえた最善の策をどのように示し、適用するかということ、２．適切なツール、

方法、戦略の利用を通じて持続的な土地管理やマーケティングオプションのための最善の策を拡大すること、３．環境変動下で結果として生じる生態レジリアンスを研究することである。

第１９回レジリアンス研究会

日時：　2007 年７月３０日（月）　15:30-16:45
会場：　地球研　講演室
タイトル：　聖書を生きる
　　―南部アフリカの社会変動とその対応としてのキリスト教独立教会の展開
発表者：　吉田　憲司　（国立民族学博物館）

［要旨］1990 年ごろを境に、アフリカのザンビア東部州では、人びとのキリスト教への入信と聖霊憑依の急激な増加をみた。発表者が過去１０数年にわたって追い続けてきた、ザンビアにおけるズィオン聖霊教会の活動の現状を報告するとともに、その淵源を南部アフリカ全体に探る。

第２０回レジリアンス研究会

日時：2007 年 11 月 22 日（木）15:00-16:30
場所：地球研セミナー室３・４
講演者：Prof. Gear Kajoba, University of Zambia（招へい外国人研究員）
タイトル：Vulnerability and Resilience of Rural Society in Zambia: From the View Point of Land Tenure and Food Security
ザンビア農村社会の脆弱性とレジリアンス - 土地所有制度と食料安全保障の観点から

[要旨]
植民地前のザンビア農村社会では、農業システム生態系は一般的な環境条件に対し持続的かつレジリアントであり、従来の共同体的な土地保有の下で食料安全が保証された。

しかし、植民地政策による労働移動と土地分配により、Bemba 族のチテメネシステムや Lozi 族の氾濫原での耕作等の生産システムは影響を受け、男性不在により農村地域の脆弱性が高まる結果となった。一方、ザンビア南部のトンガ族は、ハイブリッドメイズや牛耕等の近代的耕作技術を積極的に導入し、土地制度も共同体的所有制度から個人所有へと変化させ、レジリアンスの高さを示した。

１９６４年の独立以来、UNIP 政権は強力に地域開発を推し進め、メイズ生産の補助

や、植民地政府の土地制度を維持する保守的政策を実施した。しかし、食料安全は保障されず、小規模農民が政府とメイズのみの生産に過度に依存する状態となった。

MMD 政権により１９９１年から２００１年までに実施された新リベラル政策は、天候の不順も災いし、政策や環境変動に対する食料生産システムの脆弱性を増大させた。しかし、２００１年以降現在に至るまで、土地所有のエンパワーメント政策により、男性女性ともに土地所有を保証し、地域社会のレジリアンスを再構築するための政府の介入政策が行われており、国家と世帯の食料安全保障を推進する努力がなされている。

第２１回レジリアンス研究会

日時：2008 年 2 月 15 日（金）15:00-16:30
場所：地球研セミナー室１・２

講演者１：中村哲也（京都大学大学院アジア・アフリカ地域研究研究科）
タイトル：ザンビア南部丘陵地における農耕民トンガの生業に関する研究
[要旨]　1950 年代後半に、ザンビア南部のザンベジ河ではダムの建設に伴い、大規模な人口湖がつくられた。その結果、5 万人以上のトンガ人が移住を余儀なくされ、湖畔平野部へと移動した。しかし、彼らはそこで、干ばつと慢性的な土地不足に悩まされ続けた。こうした背景のもと、平野部から再び移住する人が現れ始め、調査地はその候補地のひとつであった。

調査村は、湖畔平野部と高原地帯の間のミオンボ林に覆われた丘陵地に位置する。発表者は、平地で農業を主たる生業として暮らしてきた「農耕民」トンガが、丘陵地という環境のなか、どのような生業を営み生計を維持しているのかについて、彼らの社会構造との関連で考察することを目的としている。

講演者２：伊藤千尋（京都大学大学院アジア・アフリカ地域研究研究科）
タイトル：農民の生計戦略としての出稼ぎ労働―ザンビア南部州の事例から―
[要旨]　アフリカ農村は農業を基盤としているが、現金経済の流入によって農業のみで生計を維持することが困難となっている。そこで、農民は生計を多様化させ、起りうるリスクに対応してきた。ザンビアの農村地域でも、農業活動は現在に至るまで重要な世帯収入源となっているが、古くから「出稼ぎ労働」をはじめとする農外活動が農家世帯の経済にとって重要な役割を果たしてきた。

ザンビアは植民地期から国内外への労働移動が盛んであったが、それらは鉱山やプランテーションへの労働力供給という文脈で発生し、現在の農村からの出稼ぎ労働とは形態も背景も異なっている。そこで、本報告では出稼ぎ労働を農民の生計戦略の一つとして捉え、農村への影響とその役割を明らかにすることを目的としている。今回の発表では、調査村における出稼ぎ労働の特徴を紹介し、その役割を検討したい。

平成19年度1－3FR(梅津FR)研究活動一覧												
2007	4	5	6	7	8	9	10	11	12	1	2	3
レジリアンス	13:00-17:00		11:00-17:00	15:30-16:45				15:30-16:45			15:00-16:30	
研究会	4月23日		6月20日	7月30日				11月22日			2月15日	
	(第17回)		(第18回)	(第19回)				(第20回)			(第21回)	
コアメンバー会議	＊4/23		＊6/20	＊7/19					＊12/17			*3/8
ワークショップ		5/11-12 WS				9/3 ルサカWS						3/7-9 小樽WS
		9:00-17:00				9:00-17:00						8:00-18:00
レジリアンス勉強会										*1/19	*2/17	*3/15
観測機器設置	機器発注			機器納入	搬送(上旬)	現地到着・受取・設置・観測開始						
				7/19雨量計講習会								
FR報告書									FR報告書原稿締切		2月末製本	
予算計画	平成20年度					追加予算申請	追加予算決定		追加予算申請	H20予算計画		
	概算要求(4/9)					9月22日	10月23日		12月上旬	雇用計画		
プロ関連行事												
		(IS申請 5/7)				(FSヒアリング)			プロジェクト			(FSヒアリング)
		ISヒアリング5/17				9月21日			研究発表会			3月6日
									12月12-14日			
地球研行事				地球研フォーラム			地球研国際シンポ		コープイン京都		評価委員会	
				7月7日			10/30-31				2/28-29	
				京都国際会館			ミエルパルク					
フィールド調査日程												
真常	3/15-4/18		5/16-6/13				10/20-11/30					3/5-3/24
田中			5/26-6/10					11/2-18				3/14-3/28
宮嵜						8/31-4/30	(8ヶ月滞在)					
野呂(M1)			5/16-6/13		8/22-9/5		10/6-12/24					
三浦			5/16-6/13									
柴田			5/27-6/10									
櫻井	4/2-4/18					9/12-10/12						
菅野	4/2-4/18					9/15-9/25						
山内						9/15-9/25						
島田			6/16-6/23 (UK)		7/28-8/11						2/20-2/28(S.A., Lesotho)	
石本 (D3)								10/29-1/31 (Burkina Faso)				3/14-3/28
成澤(D1)											2/10-3/29	
伊藤(M2)	3月帰国											
中村(M2)	2007年春まで調査を継続			7/11帰国								
姜 (M1)											2/18-7/26 (6ヶ月滞在)	
吉村					8/22-9/5							
佐伯						8/31-9/26						
山下					8/22-9/5							
松村						8/31-9/28		10/29-11/9				
梅津						8/31-9/26						3/19-3/29
Lekprichakul						8/31-10/13			12/26-31(Bangkok)			3/19-3/29
久米							10/22-31(India)					3/9-3/21(India)
Mwale(招へい)	4/1-6/30	地球研										
Kajoba(招へい)							10/1-12/31	地球研				
Flint (招へい)											2/4-5/3	地球研